NATURE

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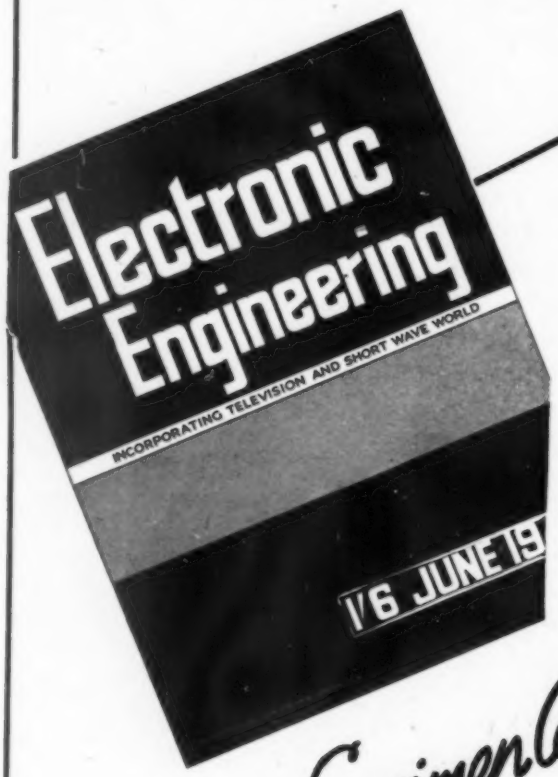

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Vol. 147 SATURDAY, MAY 17, 1941 No. 3733

THE SELECT COMMITTEE OF NATIONAL EXPENDITURE

WHILE the statement on science and the national effort which Lord Hankey made in the House of Lords on April 2 (see NATURE of April 12, p. 432) of necessity adds little to an earlier statement by Lord Chatfield last year, it gives an admirable reply to certain criticisms of the use being made by the Government of our scientific man-power, and with little supplementing could well be used by the scientific worker to educate public opinion as to the part which science is playing in our war effort. It was, of course, well-nigh impossible for Lord Hankey to cover the whole field in any detail in the time at his disposal, but there are at least two respects in which from the point of view of educating public opinion his statement might perhaps have been amplified.

In his reference to the achievements of Nazi Germany in the field of science, Lord Hankey contented himself with the assertion that our men of science are at least as good as his. Without adulation of our own achievements in this respect Lord Hankey might well have pointed out that the domination of science by the State under the Nazis and the proscription of freedom of thought and investigation, apart from racial persecution and discrimination, have not only robbed Germany of many of her ablest workers, but have also made German science static. As Mr. W. Kæmpffert points out in an article "Science in the Totalitarian State"*, while science can exist in a totalitarian regime, it will be a frozen science. Science can only be a powerful social force for good when the individual worker is permitted to enjoy the fundamental freedom of democracy—to work without intellectual restraint.

* *Foreign Affairs*, January, 1941.

Lord Hankey might well therefore have referred more explicitly to the way in which the existence of creative science and an independent scientific outlook are bound up with the existence of democracy and have pointed to the decadence of science in Nazi Germany, as Dr. C. J. T. Cronshaw did in his recent address before the Society of Dyers and Colourists. Dr. Cronshaw made the important point that Germany is fighting this war on the technical progress and skill of a generation which is running out and which in calibre, training and experience is not by great lengths matched by succeeding generations. Bias and prejudice had destroyed progress.

Reference to the work of the Select Committee of National Expenditure would also have been appropriate and useful. There are in fact few bodies which are doing more to inculcate a scientific outlook and approach to the national effort than this Committee in its admirable series of reports. Its searching but constructive criticism is designed not merely to eliminate waste but also to encourage that impartial and comprehensive view of affairs which is of the essence of the scientific spirit. Tribute to such work in Lord Hankey's statement would not have been more appropriate than deserved. The Scientific Advisory Committee takes a narrow view of its functions if it fails to recognize the assistance it is receiving both directly and indirectly from this Select Committee.

The value of the latter's work is indeed cumulative, and the very existence of such a committee is striking evidence of the inherent healthiness of the democratic system and its capacity to rectify weaknesses or abuses, given the will or driving

power. The impartial but severe and searching criticism of the Sub-Committee on Air Services, in the Select Committee's Ninth Report, of the Air Ministry's practice of price contracts for the preparation and construction of aerodromes, the equally severe condemnation by the Sub-Committee on Supply Services, in the Seventh Report, of the Ministry of Works and Buildings for the absence of unified control over constructional work, and also the strictures, amounting almost to censure, on the Ministry of Transport and other Government departments in the Eighth and Tenth Reports would not be possible under a totalitarian regime, with its stifling of independent judgment and impartial analysis. Such constructive criticism is at once the strength and opportunity of democracy, provided only its leaders and institutions are capable of profiting by criticism and applying it without prejudice and with firm resolution to the remedying of the weaknesses disclosed.

These latest reports from the Select Committee, no less than the earlier reports, are in fact a searchlight on the position of and opportunity for scientific management in Great Britain. There are few factors more vital to the efficient conduct of our war-effort than scientific management, and if in his recent speech in the House of Commons Mr. Bevin did less than justice to some of the factors on the labour side which impede production, his indictment of management was fully justified in many quarters and is substantiated by evidence in these reports. There can be no place in our war-effort for management or directorates which wilfully ignore dearly purchased experience with regard to hours of work, the value of canteens and other problems in industrial psychology in which in the last twenty-five years so much work has been done by the Industrial Health Research Board, the National Institute of Industrial Psychology and by other bodies.

Many of the weaknesses which call forth the severest criticism of the Select Committee are due fundamentally to neglect of such experience or of established principles of management. It is indeed startling to find that it is still necessary to put emphasis on supervision, whether at the top to secure unified control, by the appointment of one man with the maximum authority to be in charge of each building or group of buildings in course of construction, or in the provision of skilled supervisory staff on the site. The neglect of management principles and experience thus revealed in the Seventh Report is exactly parallel with similar criticism of the Air Ministry's failure to inquire into the most economic management of labour and materials on the site, or to supply adequate supervision in aerodrome construction, and with the neglect in the exchange of technical knowledge which is the subject of comment in the same report.

The importance attached by the Sub-Committee on Air Services to the pooling of ideas and knowledge has a direct bearing on Lord Hankey's statement. It indicates at least one point in which there is some hiatus in the application of scientific and technical knowledge to the war-effort of the nation. A further point is indicated in the Sixth Report of the series, in which the Sub-Committee on Trade, Agriculture and Economic Warfare reviews the work of the Ministry of Agriculture and Fisheries.

The Sub-Committee has been impressed by the statement of witnesses that what is required to improve the standard of British farming is not so much further research work and the development of new scientific methods as the translation into practice of certain simple lessons already clearly taught by scientific study and by the experience of progressive farmers. This is largely the task of scientific exposition, to which the P E P Report on Agricultural Research in Great Britain directed particular attention in November 1938, and which was the subject of some of its most important recommendations. The great need is to find sufficient numbers of men combining knowledge with practical experience to give this instruction and advice by personal visits.

Beyond this, however, the Sub-Committee points out that action is required to ensure getting full value from the County War Committees' powers. Instructions should be issued to ensure that valuable data resulting from the Committees' experience are recorded and collated, that the experience gained and ideas developed by one Committee are made available to others, and that the fullest advantage is taken of experience gained from direct farming by the County Committees. Considerable importance is also attached to the strengthening of the Economic Intelligence Division of the Ministry, both in staff and in authority, as the chief safeguard for continuity of policy and for holding the balance between contending enthusiasts.

These recommendations, designed to facilitate all the resources of science being readily available for the solution of war-time problems, well illustrate the way in which the Select Committee's reports supplement the picture of science and the national

effort given by Lord Hankey. There is, however, one further aspect, particularly stressed in this Sixth Report, to which Lord Hankey referred, in which the reports and the statement are complementary. Lord Hankey referred finally to the way in which British men of science and the scientific resources of the Empire and of the United States are building scientific equipment destined to play an ever-increasing part not merely in our war-effort but also in the period of reconstruction that must follow. The Select Committee in its Sixth Report stresses the importance, as the War proceeds, of shaping plans for post-war policy with progressive definition.

It is pointed out that the two issues—war-time food production policy and long-term agricultural policy—are closely interlocked. A complete review of the opportunities for improving the fertility of the soil would be valuable both for war and for post-war purposes, particularly a review of what can be done to improve drainage. Again, the general method for giving a sound foundation to the agricultural industry might well be the same for both the war and the post-war periods, although their detailed application might differ. The essential need for creating confidence in post-war policy as a measure for encouraging the war effort means that in agriculture especially the two must to some extent be considered together.

To this end the Report suggests that the Ministry might collect and prepare adequate material, to be issued in due course as a White Paper, so that when the appropriate time comes Parliament would have before it the basis for a comprehensive plan for maintaining, after the War, a healthy and well-balanced agriculture as an essential and permanent feature of national policy, in accordance with the Ministerial statement of November 26. It is only by continuity of policy that confidence can be created and waste avoided.

Similarly the investigation of deficiencies in the system for the distribution of vegetables which may both lead to waste and discourage production should yield results as valuable after as during the War. Again a comprehensive plan for crop production must take account not only of agricultural conditions and the need for balanced production with proper rotation of crops but also of the nutritional requirements of the country and the nature and quantity of imported food supplies which will be available. The Scientific Committee which has been set up by the Government to advise upon these problems may well lead to marked improvements in the nutrition of the nation after as well as during the War, and here again, the Select Committee observes, it may be possible to pass, as experience is gained, from the stage of tentative direction to the formulation of a definite and comprehensive plan.

These reports of the Select Committee accordingly make heartening reading in days when sterner sacrifices and more strenuous efforts are being demanded of every citizen. They show that scientific minds are resolutely probing into weaknesses and inefficiencies in our war-effort and pointing the way to eliminate them. Still more, they afford solid and renewed grounds for confidence that the sacrifices and effort demanded of us will not be in vain. It is not merely that obstacles to progress are being loosened and the way cleared for advance. In the midst of our war-effort there are slowly but progressively emerging the lines of policy and the plans which will shape a new era in which science may prove itself a growing social force for good in the democracies it has helped to victory.

THE FEEDING OF LIVESTOCK

The Principles and Practice of Feeding Farm Animals

By E. T. Halnan and Frank H. Garner. Pp. x+359+8 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1940.) 15*s*. net.

THE stress of totalitarian war has quickly revealed the fundamental instability of systems of livestock husbandry which are largely dependent upon supplies of imported feeding-stuffs. In an industrialized State, concerned to maintain a large export trade and with a large investment of capital in the less-developed regions of the world, it is inevitable that the national agricultural economy should provide for a considerable absorption of imported grain, oil-seeds and other primary produce. If this absorption has developed beyond the limits of security for war conditions, the blame, if blame there be, cannot

be placed upon the farmer, since he has little option but to adjust his system of husbandry to the economic environment created by national and international policies.

The direct responsibility which he must accept is that of avoiding waste in his use of feeding-stuffs, especially when, as now, both private and national interest make this imperatively necessary. That the avoidance of waste is to his own material interest at all times is plain, but the precept is nevertheless all too often honoured 'in the breach' on the farm, partly through the practical impossibility of maintaining a precise control of supplies, and partly through the natural repugnance of the good stockman towards any stinting of food to his charges below the full limit of their appetites.

That the physiological economy of utilization of food tends to fall long before the extreme limits of appetite are reached has been abundantly demonstrated, and more often than not the same is true of the financial economy of the process. In so far, therefore, as the supply of food to the animal is based upon economic considerations the need for controlled feeding is obvious, and much of the effort of the nutrition investigator engaged upon agricultural problems has been directed towards ascertaining for the different classes of livestock the levels of food-supply at which the maintenance requirements and productive activities of the animal can be covered with minimal waste of food. Such 'feeding standards' have been tabulated from the earliest days of agricultural nutrition science, but it is only within the present century that they have attained a sufficient degree of precision and conformity with farm experience to secure the confidence of the farmer and his practical advisers. Towards this end the spread of technical education among farmers through the improved training of new recruits and other forms of educational effort has also made a powerful contribution. But for this it would have been impossible to apply to the industry a national system of rationing of food supplies so closely adapted to its varying needs as that now in operation.

Although much of the newer knowledge of nutrition has little practical import for the greater part of our animal husbandry, it is none the less necessary for the farmer and student to be adequately informed as to the full range of the fundamental requirements of the animal. At one extreme where natural foods and outdoor environment enter largely into the system of management, the stockman will have little concern except to ensure adequate supplies of nutritive energy and of protein, and will have little anxiety as to the concurrent supply of vitamins and essential mineral elements. Where, on the other hand, the system is highly 'intensive' and artificial in character, as in the case of a large part of our pig and poultry husbandry, and some part of our dairy husbandry, the full range of nutritional knowledge must be taken into practical account.

Although the British agricultural research organization has made a large and valuable contribution to this knowledge it has produced as yet only a very modest output of literature designed to meet the needs of the farmer and agricultural student. So far as the mere exposition of fundamental principles and the advance of scientific knowledge is concerned these needs are adequately met by American and Continental literature; but the discussion of their application in British farm practice can obviously only be dealt with effectively by authors who are familiar with the systems and environmental conditions under which livestock management is conducted in Britain. The required amalgamation of science with practice is perhaps most effectively met by collaboration of nutrition scientist and agriculturist, supplied most appropriately in the present case from the personnel of the Cambridge School of Agriculture, which for the past thirty years has been a leading centre of agricultural nutrition research. One might have expected the Cambridge authors to have been primarily concerned to cater for the needs of students; but in terms of printed pages and detail of exposition this present volume is more largely a practical manual than a scientific text-book. In the introductory section dealing with the principles of nutrition a high degree of compression has been exercised and not a single reference to original literature is cited. It will not satisfy the student and will probably be found rather difficult reading by the farmer not well versed in science. What is dealt with most fully and admirably throughout the whole work is the modern technique of control of rations to secure efficiency with economy. On this aspect of the subject it gives the best exposition yet available and will form the standard work of reference for student and farmer alike. One could only wish that the plain application of science had not been so largely obscured by the inclusion of a mass of practical detail that requires no new exposition.

In their attempt to cater for both student and farmer in one volume the authors have certainly come near to success, except for the needs of the more advanced student. Theirs is not the text-book for which degree and diploma students have long been waiting; but it may be warmly recommended to the larger farming public which is more concerned to know how to apply modern methods than to understand the scientific basis upon which they rest.

CHARLES CROWTHER.

THE GENESIS OF PRINTING INKS

Printing Inks
Their Chemistry and Technology. By Carleton Ellis. Pp. 560. (New York : Reinhold Publishing Corporation ; London : Chapman and Hall, Ltd., 1940.) 42*s*. net.

THE printing-press has without a doubt been one of the greatest factors in the progress of man. The name of the supposed inventor of printing from movable type is known to all informed people, but it is now fashionable for scholars of history to dispute the claim of Gutenberg and give the credit to one Coster of Haarlem. Apparently the most convincing German records discovered at Mainz in 1740 are held to be forgeries. The British at least can still pay tribute to Caxton for his share in bringing the printing-press to our shores.

The press needs paper and ink besides type to produce a book, and it is a proper question to ask who invented ink. All we know is that the forerunners of ink and paper were not developed prior to 4000–2000 B.C. simply because there was no need for them. Writings were few, slaves were many ; characters were incised in stone tablets or marked on clay which was later baked in kilns.

The Egyptians used dyes to colour the engraved markings to make them more conspicuous—a suspension of coloured charcoal and gums in water. As trade expanded there was need for a more portable and convenient writing material and papyrus sheets came into use as long ago perhaps as 2500 B.C. Later papyrus met with competition from parchment and vellum, but not until the third or fourth century A.D. This delay may have been because leather was in demand for many other uses.

The earliest inks used on papyrus consisted of soot or some other finely divided form of carbon suspended in a varnish containing a drying oil ; for red inks iron oxide was used. Such pigments have retained their colour over a span of almost five thousand years. Mention is first made of inks which penetrated the body of the sheet rendering erasure much more difficult about A.D. 50. Pliny apparently used a suspension of lamp black and copper sulphate in water.

Indian ink, which of course has nothing to do with India, was developed by the Chinese at the beginning of the third century. The chief ingredient was lampblack, pounded through fine silk to reduce its size ; this was made into a paste with glue, water, the whites of several eggs, cinnabar and musk. After prolonged grinding in a mortar the ink was cast in sticks and was sold and used in this form until the reservoir pen ousted ink from the writing-table. Kipling records that he used it at Bateman's in preference to any other ink ; my father always had a stick on his table and a small round white dish in which to rub it down in water for use on special occasions. The art of ink-making became very widespread and important in China, and Indian ink was long recognized in Europe as the finest quality of black.

The quill pen which permitted the use of a more liquid ink was the last invention of note before the dark ages following the fall of Rome. For five hundred years or longer progress was left to the monks. Gall inks came to Europe from Arabia about A.D. 1100 and gained increasing popularity in the monasteries. All this time there was no call for the multiplication of documents ; such copies as were required were made by the monks in their abundant leisure, but by 1400 the invention of printing was at hand. Carved wood blocks were cut for the illustration of the text of a scribe who filled in the written matter by hand, and it was not a far cry to place the text on the same block. The next step was to develop the art of printing from movable type.

The earliest printing ink contained sulphate of iron in combination with vegetable astringent matter and with very little carbon. Before long inks made of linseed oil and lampblack, applied to the surface of the type with inked pads, were used. About 1823 an ink formula consisted of linseed oil, rosin and hard soap added so that the ink would leave the type easily. To-day in printing inks the craftsman ink-mixer has given part-place to the man of science.

This book takes 450 closely written and printed pages to tell us all about vehicles and pigments, driers and modifiers. There are also very many special types of inks which may be employed on a great variety of materials often at high speeds of printing. There are many ink problems in the production of a newspaper at high speed on paper of poor quality—a discussion of these takes up many pages. In short, it is possible to write an erudite and practical monograph on the subject of printing inks alone. The name of Carleton Ellis is a guarantee that the work is accurate, thorough and comprehensive. He has enriched so many fields of applied chemistry by his writings and it is a melancholy thought that this must be the last, for he recently died. The printed book, magazine or newspaper is the commonest thing in

the land; to be bought for a copper or two, glanced at and thrown away. Few readers spare a thought to the lives and ingenuity devoted to giving them type, ink and paper; least of all do they realize how much applied science, peaceful science is responsible for their merits and cheapness. If NATURE had to be produced by the monks and the few copies were handed from one to another, there would be perhaps more appreciation of its contents, but its missionary value would be less.

Carleton Ellis has done good service to the end of his useful life by producing this monograph.

E. F. ARMSTRONG.

SOIL FERTILITY AND NATIONAL HEALTH

An Agricultural Testament

By Sir Albert Howard. Pp. xvi + 254 + 13 plates. (London, New York and Toronto: Oxford University Press, 1940.) 15*s*. net.

THE strong criticisms of the agricultural practices in many countries at the present day, and of the aims and technique of modern agricultural research made in this book, are based upon the author's work and experience during a period of forty years in the West Indies, India, and Great Britain. It is with the process of manufacturing compost evolved in the Institute of Plant Industry, Indore, Central India, between the years 1924 and 1931, that the name of Howard is more particularly associated in agricultural circles.

The key of the arguments used in these criticisms is stated in the following quotation from the chapter on the nature of soil fertility: "The wheel of life is made up of two processes—growth and decay. The one is the counterpart of the other. . . . Humus is . . . an essential material for the soil if the first phase of the life cycle is to function. . . . Its presence in the soil is an essential condition for the proper functioning of the second contact between soil and plant—the mycorrhizal relationship".

The methods adopted to maintain soil fertility in China, and under the old mixed farming systems of a large part of Europe, are quoted as examples of successful stabilization of agriculture without loss of fertility, in contrast to the "soil mining" methods characteristic of "Western agriculture", to which the United States Soil Conservation Service is now devoting so much of its attention.

The book as a whole and the chapter on present-day agricultural research in particular contain a great deal of criticism of the "NPK mentality" which originated with Liebig in 1840, and was revived, following a temporary lull, with great vigour in the years following the War of 1914–18, when the factories then engaged in the fixation of atmospheric nitrogen for the manufacture of explosives had to find a new market.

The agricultural literature during this last period is full of the results of innumerable field experiments "bewildering in their volume, their diversity, and often in the conclusions to be drawn from them. By a judicious selection of this material, it is possible to prove or disprove anything or everything". Mathematics was introduced to give a greater measure of reliability, field plots were replicated and randomized, and the figures subjected to a rigid statistical scrutiny. During this "age of the manure bag", there has occurred an increasing loss of soil fertility, an increase in crop and animal diseases, a decrease in the standards of human health and nutrition, and the apparent futility of the work of plant breeders, who produce new varieties with an increased yield which can be obtained only at the expense of more soil capital.

The present situation must be saved by the community as a whole, if a *C*3 population is not to be created, "fed on improperly grown food . . . bolstered up by an expensive system of patent medicines, panel doctors, dispensaries, hospitals, and convalescent homes". In the United States alone it is estimated that no less than £700,000,000 a year is spent on medical care.

Much of the book is devoted to a description of the actual technique involved in the Indore process, and to its practical application and development. The crops considered are tropical or sub-tropical in nature, but there are also interesting comments on grassland management, orchard management and similar subjects.

It is probable that many of the criticisms and provocative statements made in this book will be answered to some extent by the major trend in world agriculture towards the increased use in many countries of grasses and legumes, and particularly of the temporary ley, in farming rotations. In this way, fertility, structure and organic matter content of the soils, whether formerly in permanent grassland or mono-cultivation, will be greatly improved in a healthy way, without the need for excessive use of the chemical dopes which, according to the author, are poisoning the nutrition

of crop plants, domestic animals and human beings.

The other important method of returning organic matter to the soil, namely, the practice of green manuring, is approved of, if the crops grown for this purpose are cut and used to provide material for composting, leaving only the root system to decay in the ground and thereby considerably reducing the burden on the soil.

R. O. WHYTE.

COLONIAL ADMINISTRATION

Democratise the Empire

A Policy for Colonial Change. By W. M. Macmillan. (The Democratic Order, No. 6.) Pp. 64. (London: Kegan Paul and Co., Ltd., 1941.) 1*s.* net.

ON the first page of this arresting, and indeed, challenging pamphlet, the author says, "on the face of it, Empire, the government of weaker peoples by a power outside themselves, is the very antithesis of the Democracy for which we stand". The truth, of course, is that in a too rapid development towards independence there is great danger lest a country, lately brought within the orbit of modern civilization, be controlled by the well-educated few who will not be subject to the checks of an informed and articulate population. In such checks lies the real strength of a democratic constitution.

Prof. Macmillan recognizes this, but he maintains that the pace has been too slow and that British Colonial policy has suffered from *laisser-faire*, particularly in the economic sphere, one on which he is very competent to speak and on which he has many interesting things to say. He praises the 'tripartite Co-operation' of the cotton-growing enterprise in the Sudan, whereby the Government met the cost of a large-scale irrigation scheme, the Sudan Plantations Syndicate provides expert management and the peasants receive a fixed proportion of the price of the cotton when sold. This principle, he says, might be applied to mining, public utility services, plantations, and so on. Some of the profits might be returned to the people in the shape of improved welfare services.

There are many who would also like to see experiments made in 'co-operation' (in the technical sense) especially among the inhabitants of the rural areas, combined with a scheme for the education and development of the people based on their indigenous culture and traditional way of life. Such experiments might well follow the suggestions contained in a memorandum emanating from the Colonial Office Advisory Committee and entitled "The Education of African Communities".

It is impossible in a short article to discuss the many aspects of the Colonial problem upon which Prof. Macmillan touches. This small book is packed with interesting and suggestive comments.

The main theme, however, is political structure. He is somewhat critical of 'Indirect Rule', which is now an accepted principle of government in some of our Colonies. He recognizes its value as a form of local government, provided that it is not considered "as the last word in the Government of any people". In due course the people will rightly demand control of the non-native supreme authority, and he asks what machinery we can provide but representative institutions.

The real justification for 'Indirect Rule' is that it represents an important educational stage. In its present form it is a means and not an end in itself. Moreover, 'Indirect Rule', adopted in many African Colonies, cannot be applied to such Colonies as the West Indies, where tribal tradition and authority do not exist.

If 'Indirect Rule' is to be not merely a temporary expedient but also to supply the basis of future Government, there must be clear vision of the end in view and the means for attaining it. It is for the British Government to see that the successive stages in each Colony are reached as soon as local conditions make such advance possible. That the British Government is prepared to shoulder this responsibility is indicated by the steps already taken to make a survey in each area of the political framework, economic possibilities and the various human problems involved, as a first step towards formulating a progressive policy. The immediate goal appears to be gradually to develop, from indigenous institutions, forms of local government embracing far larger areas and sections of the population than those from which they have sprung, and federated under a central council which derives its authority from them. The people themselves will eventually have to decide in the light of experience gained during this educational period, to what extent modifications suggested by European forms of democracy may be desirable.

It would be out of place here to mention international problems involved in our own Colonial policy, but there is one outstanding difficulty within our boundaries which must be faced. It is that of reconciling the natural aspirations of the African population with the claims of Europeans in areas of white settlement. The problem is one of immense difficulty, but if handled firmly and handled quickly, there is no reason why it should prove to be insoluble.

E. R. J. HUSSEY.

INDUSTRIAL PSYCHOLOGY FOR FOREMEN

The New Techniques for Supervisors and Foremen

By Prof. Albert Walton. Pp. vi+233. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 17*s.* 6*d.*

THIS is a remarkable book written by an author of remarkable experience. "The new techniques" which it describes, in elementary fashion, are those of industrial psychology. "Management," he says, "faced with the absolute necessity of adopting the new techniques" crudely employed by the early efficiency engineers in the United States, "yet finding that their introduction was always the signal for labor troubles, finally recognized that the problem was, in its essence, a psychological one. They turned to the university psychologists and asked them what could be done about it. Bred in the cloistered peace and quiet of their campus laboratories, these psychologists were not of much assistance. They had no experience in the workaday world, and most of them were not inclined to venture into it to attack the monumental problem which they had been asked to solve. Here and there a bolder spirit was found who could see not only the tremendous interest which might be aroused by work in the field but the vital necessity for finding a solution. . . . A few pioneers took up the work and soon found they had entered a rich field in resources and awaiting only careful research to yield a wealth of practical values not only to the industry but to general psychology itself" (pp. 104–5).

Prof. Walton was not one of these academic psychologists. He was more than forty-five years old when he entered the University of Washington in Seattle as an undergraduate student in psychology. He had, when a youth, graduated at Cornell as a mechanical engineer, after which he was engaged for twenty-five years, he tells us, "in the field of industrial engineering, part of the time with such organisations as Westinghouse and General Electric, . . . and part of the time as a consulting industrial engineer with my own office and private practice" (p. 1). He regarded his new career of a psychologist as one "in which age would be no barrier but rather an advantage". From Seattle, after taking his master's degree, Prof. Walton proceeded to Stanford University where he taught classes in psychology, took his doctor's degree, and then served as instructor in psychology, until he accepted his present post of assistant professor at the Pennsylvania State College. Here he has been teaching industrial psychology in "foreman training classes in the various industrial plants around Philadelphia and the territory within a hundred miles of the city" (p. 3). Thus he "came into the field of psychology after a quarter of a century in the active world of industry, looking", as he says, "for something usable, something that I could apply to my own situation" (p. 3). The present volume virtually contains what was covered by this course in industrial psychology for foremen, and concludes with an appendix giving notes of supplementary discussions attended by those who had already been through the earlier course.

There are many details in this book with which the 'pure' psychologist may not agree. He will object to the definition of psychology as "the study of the mind, which is what we think with" (p. 8); but the author fully realizes the important part played by the feelings, drives, motives and by what he calls "intents". He will object to the statement—"The only way we know anything about the mind is by what the body does" (p. 11); but the author is clearly far from being an extreme 'behaviourist', for although he urges that "interviewing is not a satisfactory way of securing an estimate of a man's abilities" (p. 19), possessing, as it does, the weakness of allother 'subjective' methods of investigation, he concedes later that "in no test program with which we are familiar has it been proposed to do away with the interview entirely and to place sole responsibility on tests. The test is to serve as an aid to the personnel department and to the supervisor" (p. 66). The psychologist may also cavil at the statement that instinctive reactions "and a few reflexes are all the child has at the outset. All else is learned" (p. 26), and at the exaggerated distinction drawn between what is innate and what is acquired. But it becomes clear that this and many other criticisms arise mainly from the need for extreme simplicity of initial statement, having regard to the previous education of those whom the author is addressing.

It is from this point of view that the book should be judged; and no fair critic can read it without admiration and appreciation of its almost perfect fitness for its purpose. It should be read by every progressive departmental manager and intelligent foreman in English-speaking countries.

C. S. MYERS.

PHARMACOLOGY WITH GRACE·

Pharmacology
By Prof. J. H. Gaddum. (Oxford Medical Publications.) Pp. xv+408. (London: Oxford University Press, 1940.) 17*s.* 6*d.* net.

IT is characteristic of the author of this book that he should call it by the unencumbered title "Pharmacology"; not "An introduction to" or "A Text-book of" or "Essentials of" or any other of the common attempts to avoid a simple statement of what a book contains.

This directness is evident throughout the book, which is noteworthy in the first place for the excellence of its literary style. Quiller Couch in "The Art of Writing" proposes that writing should be appropriate, accurate, perspicuous and persuasive, and has explained those terms in a way which makes it clear that if there is one form of training which should make better writers than another, it is scientific training. Certainly those engaged in scientific research have a constant stimulus to be accurate and perspicuous; if they cannot make their deductions clear to others, they do not understand them themselves. The processes of Nature which they study should make them modest and their language therefore appropriate, and their repeated failures, by developing their humour, should give them persuasiveness or charm.

It is impossible to refrain from quoting odd sentences from different parts of the book which indicate how pleasant it is to read. Speaking of the use of tetrachlorethylene for the treatment of hookworm disease, Gaddum says: "Many thousands of men and women have been treated with it; there have been no fatalities among the patients, but unfortunately no one knows how many fatalities there have been among the worms." In discussing sulphanilamide, used for its lethal action on streptococci and other bacteria, he gives a list of twenty-three names under which this one substance is sold, and adds: "There is no point in memorizing these names, which are given as an awful example of the ingenuity of manufacturers."

Perhaps the best one is the explanation of frequency distributions, which begins: "A certain rich man had 64 friends and gave each of them 100 marbles." It may be explained that the friends then toss coins, the loser forfeiting a marble to the winner, and continue this process six times, to furnish a diagram showing the distribution of the marbles among friends who toss fairly.

Pharmacological teaching has slowly progressed from materia medica and doses to the action of substances in the body. The teaching is still given in many schools by those who have little acquaintance with laboratory work, so that students remain ignorant of the methods which are introducing so many new remedies into medicine, and are also unable to form any opinion of the justice of the claims made by advertising manufacturers. The distinctive feature of Prof. Gaddum's book is that it attempts to fill this gap and to give instruction in the methods actually used by experimental workers. It stresses the steps which should precede the introduction of new preparations into the hospital: "In 1937, for example, diethylene glycol was introduced as a solvent for sulphanilamide, and 71 people were killed. This accident could have been avoided if a few simple toxicity tests had been carried out." Evidently, this book is suited not only to medical students and doctors, but also to chemists engaged in the manufacture of new remedies. If they are to be successful they must understand what the pharmacologist can do, and how much labour is involved in doing it.

Special mention must be made of the chapter on general pharmacology at the end of the book. It contains a very clear exposition of methods of calculating experimental errors, which is short and valuable for those with no inborn or acquired mathematical appetite.

Many features of the general arrangement of the book are original and seem an improvement on the usual arrangements. In the preface it is stated that "the information sought by examiners has been included as completely as possible". No doubt opinions will differ whether sufficient attention has been paid to this or that section, but it was certainly right to make the book no longer than it is. Since it would not be fitting to conclude without some positive criticism, it may be suggested that the view that insulin is concerned in the combustion of dextrose has been abandoned many years ago; the diabetic needs less insulin when he plays tennis.

Let us, however, congratulate the author (and the publisher) on this attractive, well-illustrated book.

J. HAROLD BURN.

THE PHYSICS OF AIR RAIDS*

By PROF. J. D. BERNAL, F.R.S.

A GREAT deal of the terrifying effect of bombs has been due to our lack of knowledge of the processes that take place. It is naturally difficult to study events which take place with the rapidity and violence of explosions, but it is not impossible, and thanks to the work of a large number of physicists in many countries before the War, and particularly in Great Britain during the War in the laboratories of the Department of Scientific and Industrial Research, we may say that the main features of the physical processes involved in explosions are becoming well understood. Naturally it is impossible to give here more than the broadest outlines of our present knowledge, both on account of its intricate nature and even more because of the requirements of secrecy.

Most of the effects of explosives on materials can be best understood by considering the explosive to generate a wave of extremely high intensity travelling through the body at a very high speed. Normally, mechanical disturbances travel in materials at the speed of sound, a speed which is determined by the square root of the ratio of the density of the body to its elasticity. Where the density is large and the elasticity small, waves travel slowly, and vice versa, the limits being between about 500 ft. a second in carbon tetrachloride vapour to 17,000 ft. a second in steel. For the high pressures which exist near explosions, much greater velocities occur. This is because the elasticity of bodies depends on the pressure; the interiors of atoms are more rigid than their outer surfaces. On intense compression a high elasticity and therefore a more rapid wave is produced. This is, of course, much more marked in gases than in solids and liquids. The velocity of sound in water may change from 6,000 to 12,000 ft. a second in the neighbourhood of an explosion, but that in air will change from 1,000 to about 20,000 ft. a second.

There is also a change in the character of the wave. High-pressure waves have not the smooth wave form of ordinary sound waves. Instead, the pressure in front of the wave rises immediately to its highest value and then falls off gradually and is followed by a phase of less than atmospheric pressure or suction (Fig. 1). The generation of this steep-fronted or shock wave is very similar to that of the waves which break on the sea-shore; the high-pressure phase of the disturbance, always travelling faster than the low-pressure phase, gets to the front, just as the top of the wave on the sea-shore, being held back less than the base by the friction of the sand, moves forward and ultimately breaks the wave. The shock wave is always breaking, as the free front portion is losing energy more rapidly than that behind and consequently, quite apart from the spreading of the wave, it is always dying down, most quickly, of course, nearest the explosion, and ultimately it degenerates into an ordinary sound wave.

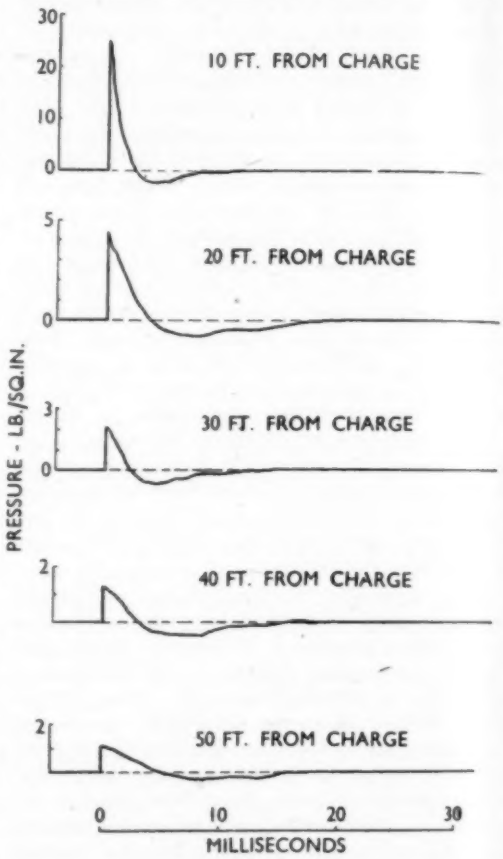


Fig. 1.

PRESSURE-TIME CURVES OF BLAST FROM 2-LB. CHARGE OF BLASTING POWDER.

* From a special afternoon lecture delivered at the Royal Institution on December 3.

The shock wave in air is what is usually known as blast and is responsible for most of the slighter effects of air raids, such as breaking of windows. The pressures needed to do this are not very considerable. Pressure peak values of 1–10 lb. per square inch, or less than an extra atmosphere, are able to break most windows, but peak pressures have to rise to about 100 lb. per square inch, or 6 atmospheres, before human beings are endangered, and this only occurs very close to explosions, so that in fact very few people are directly injured by blast. The shock wave, however, is not only an increase in pressure. Immediately behind the wave front the air is moving forward and there is an initial forward push followed by a backward pull. This, of course, can move loose objects about and throw people down or throw other things on top of them. Most injuries due to blast are only secondary in this sense and usually not very serious.

The freakish effects of blast on windows are not only due to the great variety of windows used. The shock wave behaves like any other wave in that it is reflected with more or less absorption from everything that it strikes. In streets, particularly with tall houses, this reflexion is almost complete. Consequently, a bomb exploding in a street sets up a series of reflected waves which at a considerable distance are like a periodic disturbance. If it happens that a window has a similar natural frequency, this periodic disturbance may break it by resonance. Consequently, isolated windows are often found broken at great distances from bombs.

Another so-called freak effect is due to the fact that a shock wave in a narrow street is reflected in a different way from the opening at the top of the street. A compression wave travelling in an open-ended pipe produces, when it reaches the end, a reflected suction wave, as the air having been driven out of the pipe a temporary vacuum is left behind. When this happens in a street, the reflected suction wave may be much stronger than the original suction wave of the bomb and may produce violent effects on windows and doors in lower stories, drawing them out towards the street.

A shock wave behaves in a characteristic way towards limited obstacles. Ordinary sound waves throw shadows only from the largest obstacles, such as hills or high buildings, because their wave-length is of the order of 10–100 ft. A shock wave, strictly speaking, has no single wave-length but a number of wave-lengths. The sharp high-pressure part has a very small wave-length and the tail suction part has a very long one. Consequently a shock wave passing through an aperture or round an obstacle is changed in character. Roughly speaking, the pressure part goes straight and casts shadows, whereas the suction part travels round corners without any difficulty. Thus behind a wall the pressure part of the wave may be cut down to about a tenth without making any difference to the suction part. This is very useful, as it has been shown that it is the pressure part of the wave that is responsible for most physiological damage. To have even a small garden wall between oneself and the bomb is practically to be secure from direct effects of blast. On the other hand, an open doorway is a danger and the necessity of putting baffles in front of Anderson shelter entrances applies to the blast as much as it does to the splinters.

Much of the terror attached to bombs has been due to stories of people being killed at great distances, without any physical injuries, by the mysterious effect of blast. Investigation has shown that the effect of the blast wave is that of a simple blow on the body. Most of the body is solid; the only empty parts are the lungs, and

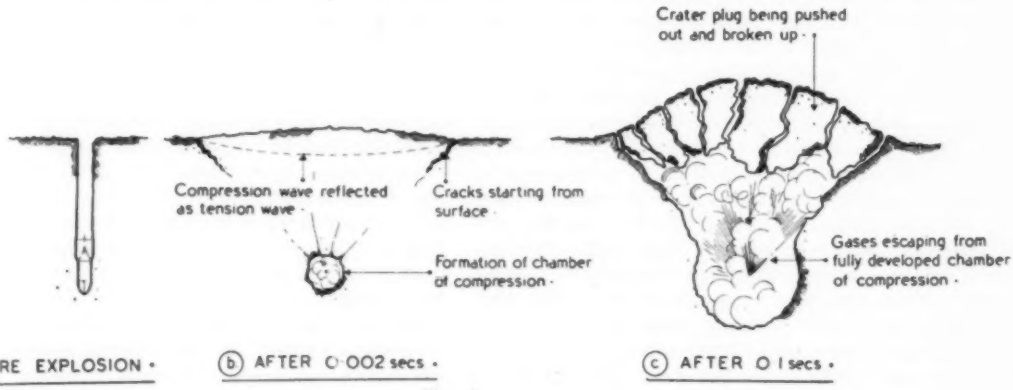

Crater plug being pushed out and broken up
Compression wave reflected as tension wave
Cracks starting from surface
Formation of chamber of compression
Gases escaping from fully developed chamber of compression
(a) BEFORE EXPLOSION
(b) AFTER 0·002 secs.
(c) AFTER 0·1 secs.

Fig. 2.

the effect of blast is essentially to bruise the lungs through the chest wall. This is effected only by the pressure part of the wave; the suction has no effect. Fortunately lungs will stand a great deal of bruising without permanent injury, and though quite a number of blast cases have occurred, most of them have recovered. Now that the nature of the injury is known, they can be treated as non-infected pneumonias, which, in practice, means only rest in bed.

Apart from blast, the main damage produced by bombs is due to splinters and earth shock. When a bomb bursts, the case first swells and then breaks up in a way very similar to the bursting of a gas cylinder under excess pressure. Failure takes place in tension along planes at 45° to the bomb surface, yielding angular fragments which are driven forward by the expanding gases. They therefore have very high velocities up to about 4,000 ft. a second and consequently have very considerable penetration into materials. The fragments are of all sizes, ranging from lumps of 40 lb. or more down to the most minute dust. As a result of experiments largely carried out since the War began, we are beginning to understand the mechanism of penetration of these fragments and the best ways of stopping them. Luckily the cheapest materials are, in fact, very effective. Three feet of sandbags have stopped any small fragment that has occurred in this War, and 13½ in. of brick will stop all but the biggest.

Only a proportion of bombs actually explode on the surface, usually on streets or concrete slabs; the great majority penetrate either into buildings or into the ground. The characteristic crater is that produced by a bomb exploding about 10–20 ft., according to size, underground. The damage done by such bombs is not due either to blast or splinters, but to the effect of the explosion on the earth. When a bomb explodes in a dense medium, such as soil, it produces a shock wave travelling at velocities which depend on the nature of the soil. As all soils get more elastic as they go deeper, the shock wave travels in a complicated way; it is reflected from the lower levels, and at distances of more than 100 ft. has already become a complex train of waves very similar to those found in earthquakes. Such waves can shake down buildings in a somewhat capricious way, depending on the natural frequencies of the building in relation to that of the waves, but generally speaking only old or badly built buildings are affected.

The most serious effects of ground shock are those nearer to the explosion, and are not due to the shock wave but to the bodily movement of the earth near the bomb. After explosion the explosive gases push the earth aside, forming an initial sphere of expansion. The displaced earth is moved outwards and quite considerable displacements occur. The displacement is partly elastic and partly plastic. The earth may be moved some inches and come back to within half an inch of where it started. This earth movement is, of course, mostly dangerous to underground structures. It is not so much an instantaneous blow as a steady pressure exerted for a time of the order of 0·1 sec. It is least effective on structures which can yield to such pressures without breaking. One of the main advantages of the Anderson shelter is its flexible character. This earth movement is usually responsible for the breaking of gas and water mains by bombs.

When the shock wave from an underground bomb reaches the surface, it is reflected as a tension wave, and if it is strong enough the ground cracks and a conical 'scab' is formed which is projected upwards, usually breaking up and leaving the characteristic crater behind. The observed crater, of course, is always complicated by the presence of material which has been thrown out and fallen back into it. The true crater is usually almost twice as deep. If the bomb is too deep, the breaking of the surface does not occur; it is simply heaved up and drops back more or less into place. This is called a 'camouflet'. Such camouflets are usually of little importance, except that they may be mistaken for unexploded bombs.

When a bomb strikes a building the effects are naturally complex, but they depend on relatively few principles. When a bomb explodes in a house its primary effect is to cause a blast wave which, meeting walls, blows them out. The effect is greater than blast in the open because the waves reflected from other walls add their effect to that of the initial blast, producing a more prolonged pressure and consequently a greater outward momentum. Except in very large halls or sheds, this blast pressure is sufficient to break the wall and project a considerable portion of it clear of the building. What happens afterwards depends on the type of the building. In favourable cases the only result is to form a hole in one or more external walls, the remaining part of the building holding together. More often the damage to the walls causes partial or complete collapse of the building. With steel-framed or reinforced concrete buildings the frame prevents the falling of the upper part of the building and holds up the comparatively small load produced by the immediate effects of the explosion.

This outline of some physical aspects of air-raid damage shows that we have a quantitative picture of the dangers of raids; this is the first step in providing rational means of minimizing them.

REGIONAL AGRICULTURAL LABORATORIES IN THE UNITED STATES

By Dr. R. O. Whyte

Imperial Bureau of Pastures and Forage Crops

DURING the past five or six years, a major development has been taking place in agricultural research in the United States, which should have a considerable effect on the rate of progress to be expected in several important problems, and on the number and scope of scientific papers published.

This development may be said to have originated officially with the signing of the Bankhead-Jones Act by President Roosevelt on June 29, 1935. This Act provided for substantially increased Federal aid for fundamental agricultural research, agricultural extension and land-grant college instruction.

The appropriations granted by Congress were 980,000 dollars for land-grant college instruction, 8,000,000 dollars for agricultural extension, and 1,000,000 dollars for agricultural research; under a sliding-scale arrangement these amounts might be increased to an annual maximum of 19,480,000 dollars by the beginning of the fiscal year 1940.

As regards agricultural research, the Act contemplated enlarged activities by both the State experiment stations and the Federal Department of Agriculture. Sixty per cent of the amount provided was to be available to the States of the Union, and Alaska, Hawaii and Puerto Rico, the funds allotted being based upon the respective rural populations, and being conditional upon the provision from non-Federal sources of an equivalent amount for purposes of research and for the establishment and maintenance of necessary facilities for the prosecution of such research.

The remaining forty per cent of the research fund was placed directly at the disposal of the Secretary of Agriculture, who was "authorized and directed to conduct research into laws and principles underlying basic problems of agriculture in its broadest aspects; research relating to the improvement of the quality of, and the development of new and improved methods of production of, distribution of, and new and extended uses and markets for, agricultural commodities and by-products and manufactures thereof; and research relating to the conservation, development and use of land and water resources for agricultural purposes" (*Experiment Station Record*, 73, No. 3, 289–91; 1935).

This research was to be conducted by such agencies of the Department of Agriculture as the Secretary might design or establish, but one half of the special research fund was ear-marked to be "used by the Secretary for the establishment and maintenance of research laboratories and facilities in the major agricultural regions at places selected by him, and for the prosecution . . . of research at such laboratories" (*loc. cit.*).

All research by the Department authorized under the Act was to be additional to any provided by existing law, but the desirability of co-ordination of activities was particularly stressed.

So far, nine of these special regional laboratories have been organized, each one being regarded as a co-operative enterprise between the various States concerned, serving as a focal point for co-ordinating and integrating research in its particular problem in its own region, and carrying on basic research along certain lines not already provided for adequately. One of the important reasons for criticizing the organization of agricultural research in the United States, namely, the fact that the agricultural experiment stations of adjacent States situated in the same geographical or agricultural region were carrying out research on very similar problems with little co-ordination as between States, has now to a great extent been removed.

As will be seen from the account of the scope and location of the new regional laboratories given below, anything from eleven to twenty-five States are now co-operating with one or other of the laboratories; the boundaries of a particular problem or branch of agricultural research no longer coincide with State boundaries, but with the limits of the region to which the problem applies more particularly.

The fundamental research for which specialized staff or special equipment or laboratories are essential is done at the regional laboratories; the research which can be carried out at the State experiment stations is still done there; but it is now closely correlated with the work at the regional laboratories, and duplication of work between any of the co-operating States is avoided.

These laboratories are, of course, quite distinct from the other experiment stations and laboratories which have been located on a regional or "problem area" basis, such as the soil and water conservation experiment stations and hydraulic laboratories of the Soil Conservation Service, or the forest and range experiment stations of the Forest Service.

The regional laboratories concerned with research on crop plants and products are three in number; four deal with animal problems, and two with soil-plant relationships.

The U.S. Regional Vegetable Breeding Laboratory (Director: Dr. B. L. Wade) is at Charleston, South Carolina, and was established to obtain the fundamental information necessary for the breeding and development of improved types and varieties of vegetable crops specifically adapted to the south-eastern region; thirteen States are co-operating with this laboratory.

The Pasture Research Laboratory has been established at State College, Pennsylvania, to carry out research on the more fundamental pasture problems of the north-eastern States, the twelve co-operating States continuing to make experiments on the more agronomical aspects. A description of the organization of this Laboratory and of the way in which it co-operates with the States concerned has already been given by its director, Dr. R. J. Garber (*Herb. Rev.*, **6**, 146–50; 1938).

The twelve States of the North Central Region are co-operating with the U.S. Regional Soybean Industrial Products Laboratory which has been established at Urbana, Illinois (Director: Dr. R. T. Milner), (1) to develop industrial uses for the soybean and soybean products, (2) to study the effects of different processes on the quantity and quality of products obtained from the soybean, and (3) to provide facilities for testing the quality and adaptability of types and varieties of soybeans for industrial uses.

The four animal laboratories deal with sheep, swine, poultry and animal diseases.

The purpose of the Western Sheep Breeding Laboratory, Dubois, Idaho (Director: Mr. J. E. Nordby), is the development of strains of sheep superior to those now in existence as regards hardiness, and yield and quality of wool and lambs, and the co-ordination of this research with that of the co-operating States (twelve) and Federal experiment stations.

The U.S. Regional Swine Breeding Laboratory has been established at Ames, Iowa (Director: Dr. W. A. Craft), to study the improvement of swine by the application of breeding methods (thirteen States in the North Central Region co-operating).

The object of the Regional Poultry Laboratory, East Lansing, Michigan (Director: Mr. Berley Winton), with which twenty-five States in the North Central and North-eastern Regions are co-operating, is to determine the etiologic agent or agents responsible for fowl paralysis, to develop procedures based upon genetics, management and nutrition, and to discover prophylactic measures for the prevention or control of this disease.

Related to this last laboratory is the work of the Regional Laboratory for Animal Disease Research, at Auburn, Alabama (Director: Mr. B. T. Simms). This Laboratory was established to obtain, with the co-operation of the thirteen States of the South-eastern Region, fundamental information of the mechanism of infection (infection, resistance, immunity) in the contagious, infectious and parasitic diseases of animals and poultry, in order that methods of control of these diseases can be developed or improved. The Laboratory is studying Johne's disease and coccidiosis and internal parasites of cattle.

A Regional Salinity Laboratory, at Riverside, California, has as its objective the obtaining of new information on the reactions of plants and the soil to known concentrations of the several constituents of the dissolved salts contained in supplies of irrigation water and in the soil solutions of irrigated lands. The Laboratory will also ascertain the hydrological and salinity conditions, and the trend of these conditions in representative areas of irrigated lands, in order that the results of these investigations may be constructively applied. Eleven States in the Western Region to which these problems apply are co-operating with this laboratory.

Finally, there has been established at Ithaca, New York, the U.S. Regional Plant Soil and Nutrition Laboratory (Director: Dr. L. A. Maynard), which has very extended terms of reference and the possibility of results which will ultimately have a direct application to the nutrition of domestic animals and the human population throughout the United States.

This laboratory has the following objectives:

(1) To investigate the possibility of influencing the type, character, composition and health of plants grown under controlled environments and in the field through the application of common, rare, or trace elements, irrigation water, sprays, or other means.

(2) To investigate under such conditions the range of variability in the amount of crop produced, the structure of the plant tissue, its mineral, organic and fibre content, and the influence of various environments and environmental factors upon vitamins, growth-promoting substances and other dietary supplemental factors.

(3) To test objectively all these values by feeding the plant produced to the usual laboratory test animals and making observations on rate of development, behaviour, condition, and eventually dietary and nutritional studies.

(4) To determine the dietary needs and tolerance of man and domestic animals for several of the known essential or toxic elements.

(5) To classify geographical regions in the United

States with respect to the adequacy of supplies of different mineral elements through correlated studies of the composition of soils, crops and animals.

(6) To determine methods of adjusting the mineral composition of plants used for animal or human food in various areas of the United States, by the addition of fertilizers carrying the desired elements or by spraying or dusting the plants, or by other means.

(7) To study the efficacy of supplementing mineral-deficient diets of man or animals by the direct addition of minerals and growth substances to the ration.

As the work of this laboratory has a nation-wide significance and application, co-operation will be arranged with those State experiment stations, bureaux of the Department of Agriculture, and other research agencies which already have special facilities and staff members especially interested in one or other of the many aspects of this research.

SCIENCE AND ART AT THE ROYAL ACADEMY

By Dr. A. T. Hopwood

British Museum (Natural History)

THE canons of art differ greatly in detail from those of science, but since intellectual honesty is the basis of both, there is no fundamental distinction between them. To make an orderly statement of accurately observed facts and from those facts to draw logical conclusions is the very essence of science; but the best art is also logical and orderly, as well as being an accurate interpretation of the impression made by the outside world upon the mind of the artist. Observe the words "interpretation" and "impression"; they are important because they lie at the very root of the matter; whereas science is, or should be, strictly objective, art is intensely subjective. For the rest, the differences are mainly those of design, technique, and of the medium of expression. Is it always recognized that there is as much skill in design shown by the well-written and well-balanced scientific paper as there is in a first-class painting, and that when J. M. W. Turner removed a castle bodily from one bank of the river to the other, because in this way he improved the design on his canvas, he was doing no more and no less than the man of science who puts one section of his paper in front of another so as to improve the balance of the whole? In so far as the man of science recognizes these differences and leaves his prejudices, which are many, outside, so his bewilderment will decrease and his interest and enjoyment increase. In this year's Exhibition at the Royal Academy much is provided to enjoy, and very little to bewilder.

The botanist is always well catered for; this time he is more fortunate than usual. Apart from the landscapes there is a very large number of flower pieces, which range from W. Rankin's big pictures in the Dutch style, highly finished and accurately drawn, to sketchy impressions incapable of recognition without recourse to the catalogue. "The Change", by Heda Armour, is presumably allegorical and so should be immune from the scientific Philistine, who contents himself with wondering when winter aconite, snowdrops, flag irises and the cuckoo all came together in the same place at the same time. The botanist, too, is this year favoured by the only obvious jest, "The Champion", by J. W. Tucker. This is a monstrous cauliflower to the grower of which homage is being paid by the mayor and corporation with the press and news-reel men in attendance. Mr. Tucker has chosen tempera as his medium and achieved his end, but painting in tempera as practised at the present day does not seem to be suitable for the successful interpretation of flowers, fruit and vegetables. Be the subject what it may, vegetable marrows, carrots, apples, or even the trunks of beech trees, the impression is always of carefully finished plaster models. Incidentally, there is no well-painted fruit this year because of the shortage; memories have played their owners false and the result is lacking in juice and texture.

Pictures for the zoologist are not many. Two of them, "The Jungle", by Shearer Armstrong, and "The Pine Marten", by Billie Waters, are purely zoological, although the monkeys in the first-named have been somewhat stylized so that one is left uncertain as to what species are intended. For the rest, there are a few shells, particularly good in Mr. Dinkel's "Flower Piece with Shells", some scrawny cats incidental to other subjects, at least one impossible fish, and various kinds of domestic animals of greater or less merit. Among the water-colours, "Flowing Tide" and "Lapwings in Spring", both by C. F. Tunnicliffe, attract attention, but it is in the Sculpture Rooms that zoological subjects are mainly to be found. The best of these are more or less conventional, as, for example, "Yearling", by Raoh Schorr—a bronze statuette of a fawn somewhat after the style of

Skeeping—and "Lamb" by H. Wilson Parker. The horses are not good; one, at least, has the shoulder muscles at fault, and another drags its off hind leg in a painful manner. Neither of the tortoises is particularly successful. The other pieces are competent rather than inspired.

Geologists and mineralogists have very little to claim as their own particular interest, but they share the magnificent painting of the jewellery in Gerald Kelly's charming portrait of Her Majesty the Queen. Precious stones are notoriously difficult to paint; Mr. Kelly has triumphed with a marked economy of pigment and a brilliant sureness of touch.

The mathematician will interest himself mainly in the laws of perspective and their application, and even though there is no solution in paint of a complicated mathematical problem to compare with Mantegna's famous "Dead Christ" or the pulsating rhythm of Uccello's "Rout of San Romano" for him to admire, he would be well advised to examine carefully "Sir Charles Grant Robertson, C.V.O.", by Meredith Frampton, A.R.A., and "Coupons Required", by Leonora K. Green.

As regards physics and chemistry, what is there which concerns them? In a sense the whole exhibition is their oyster. The chemist has a father's interest in the pigments, in their behaviour in mixture, as well as in their use or misuse, while problems of light and shade are for the physicist, who may perhaps one day see a "Portrait of a Sound", even as there has already been a "Photograph of a Smell" (Royal Photographic Society Exhibition, 1938).

Taken as a whole, the exhibits in the South Rooms are not so good as in former years, but there is a very interesting sheet of pencil studies of old agricultural implements—"Details from a Devon Farm", by Russell Flint, R.A. Not only are the drawings pleasing but they are also of historical interest, for they represent a dying phase of agriculture.

At least one man of science always takes a deep breath before venturing into the Architectural Room, for he finds the angularity of "Modern" designs uncomfortable and their curves repellent or even obscene. This year he sighed with relief to find that our English genius has once more triumphed over the upstart invader and that the native tradition still flourishes.

Many words and very little sense have been spent in discussions on modern architecture. Some of its features are admirable; such, for example, are the elimination of waste space and the planning of the fire-places so that the flues run up inside the building instead of dissipating their heat through outside walls. White houses in England there always have been, and coloured roofs as well; the change is in the substitution of more permanent materials for whitewash and in the addition of deep blue and green glazed tiles to the traditional unglazed red.

One's quarrel is with none of these things, but with the perverse body which insists on being revolutionary. The fact that steel and concrete can be made to assume certain forms does not mean that it is desirable that it should be made to assume those forms. That light and fresh air are essential to health is no excuse for designing windows so large that the illuminated rooms are impossible to keep warm during cold weather. As for severity of line and beauty of well-proportioned masses, a boot-box can be severe and well proportioned, but what is suitable for a boot-box is not necessarily suitable for a dwelling-house. There are three parties interested in houses: the housewife, who requires ease of working, the householder, who requires comfort as well as value for money paid, and the community, which has the right to demand that a building shall consort amicably with its surroundings. Unless the architect can satisfy all three he has failed. It is much to their credit that the architectural exhibits in the Academy this year make an honest attempt to fulfil these conditions; and even if there are still such curiosities as windows in which the length of the pane is horizontal instead of upright, the vulgarity of the extreme modern school—vulgar just because it is extreme—is nowhere to be seen.

OBITUARIES

Dr. G. W. C. Kaye, O.B.E., F.R.S.

DR. GEORGE WILLIAM CLARKSON KAYE, superintendent of the Physics Department, National Physical Laboratory, passed away on April 16 after a long illness. His name became familiar to students of science thirty years ago as the co-author of "Tables of Physical and Chemical Constants", which have now reached their eighth edition. He was born in 1880 and studied physics at the Imperial College of Science, then the Royal College of Science, and later at Trinity College, Cambridge. For Cambridge he retained a warm affection throughout his life, and he was at his best when showing a friend round the colleges and the Cavendish Laboratory. For a time he assisted Sir J. J. Thomson in his research work.

Kaye joined the staff of the National Physical Laboratory in 1910, and at first worked in the Metro-

logy Department on the production of a silica standard of length. In 1912 he was transferred to the Physics Department to take charge of the thermometer testing work, then taken over from Kew Observatory, and of radium measurements.

As a captain in the London Electrical Engineers R.E.(T.), he was called to the colours in August 1914 and for a time served at a Thames Estuary Station on searchlight work. Later he transferred to the Aeronautical Inspection Directorate of the Air Ministry, in which organization he rose ultimately to the position of chief inspector of materials, with the rank of major. It was in this position that he applied X-rays to the examination of various types of timber splices. The A.I.D. gave him much experience in the handling of men of many types and of committee work, which appealed especially to him. On his return to the National Physical Laboratory, he took charge of the Physics Department and was appointed superintendent in 1922. He was primarily interested in the administrative side of the work and for more than twenty years he was chairman of the Library Committee of the Laboratory.

Kaye was especially interested in the British X-ray and Radium Protection Committee, and took an active part in the deliberations of the International X-Ray and Radium Protection Commission of the various Congresses of Radiology. He gave the eighth Caldwell Memorial Lecture before the American Roentgen Ray Society in Montreal in 1927, and his presidential address to the British Institute of Radiology in 1929 was entitled "Radiology, Medieval and Modern". At one time thermal measurements attracted his attention, and a number of papers were published jointly with various colleagues.

It was not, however, until the need arose for the inclusion of the subject of sound in the activities of the National Physical Laboratory that Kaye found scope for his special talents. He took great pride in the design of the new Acoustics Laboratory, and neither time nor money was spared to ensure that Great Britain should be in the forefront as regards equipment for the study of the acoustics of buildings and allied problems. Special attention was devoted to noise measurements, on which subject a number of papers was published. These constituted the basis of his presidential address to Section A of the British Association at the Nottingham meeting in 1937. His election to the presidency of Section A afforded him the deepest satisfaction, and much time was spent in the preparation of his address, which was lavishly illustrated by experiments and with a cinematograph film.

Soon after Kaye became superintendent of the Physical Department of the National Physical Laboratory, it had become apparent that a rehousing of the Department was necessary. He undertook wholeheartedly the task of specifying the requirements of the Department and, in conjunction with the then Office of Works, in preparing the basic plans of the present structure. Many times the schemes were turned down for reasons of economy. This delay did not prevent Kaye from keeping the plans abreast of modern requirements, and features of the building have since been incorporated in other new laboratories built in Great Britain.

Kaye was the recipient of many honours, which included the Mackenzie Davidson Medal of the Royal Society of Medicine and the Silvanus Thompson Medal of the British Institute of Radiology. He was elected a fellow of the Royal Society in 1939.

EZER GRIFFITHS.

Prof. Charles Laubry

BY the death of Prof. Charles Laubry of Paris at the age of sixty-eight, the announcement of which rapidly follows that of Prof. Wenckebach's (see NATURE, March 1, 1941, p. 260), though the exact date is unascertainable in present circumstances, medical science has lost another pioneer in modern cardiology, and particularly in the application of radiology to diseases of the heart.

Laubry was a pupil of the late Prof. Vaquez of Paris, whose school exercised a great influence over current cardiological teaching throughout Europe and Latin America, though less in Great Britain and the United States. His literary output was considerable. His principal works in chronological order were: "Leçons de sémiologie cardiovasculaire. Les troubles fonctionnels" (1924), "Traité des maladies congénitales du cœur" in collaboration with Pezzi of Milan (1926), and "Radiologie clinique du cœur et des grands vaisseaux" in collaboration with Cottenot, Routier and Heim de Balsac (1939). He was also editor of the *Archives des maladies du cœur*.

In addition to his cardiological work, he was the author of the section on the symptomatology of diseases of the respiratory system in the third volume of the "Nouveau Traité de Pathologie Interne" (1938).

Like Prof. Wenkebach, Laubry had many friends in Great Britain. He delivered the Saint Cyres Lecture at the National Heart Hospital in 1937, and he was an honorary member of the Cardiac Society. He was elected an honorary foreign fellow of the Royal Society of Medicine in 1939.

WE regret to announce the following deaths:

Mr. N. C. Brown, known for his work on the distribution and habits of North American birds, on March 20, aged eighty-four.

Sir James Frazer, O.M., F.R.S., the well-known anthropologist and author of the "Golden Bough", and Lady Frazer, on May 7, aged eighty-seven.

Prof. G. L. Gulland, C.M.G., emeritus professor of medicine in the University of Edinburgh, on May 4.

Prof. L. Kahlenberg, formerly professor of chemistry in the University of Wisconsin, on March 19, aged seventy-one.

Prof. Nikolaj Konstantinovic Koltzoff, director of the Moscow Institute of Experimental Biology, aged sixty-nine; in making this announcement in NATURE of April 19, p. 474, Prof. Koltzoff's surname was omitted.

Prof. A. C. Pereira, professor of toxicology in the University of Lisbon, on December 20, aged seventy-three.

NEWS AND VIEWS

Terrorism in Aerial Attack

THOSE of us who experienced the heavy attack on London by the German Air Force on Saturday night (May 10–11) were once more convinced of its deliberately indiscriminate nature with the obvious aim of striking terror into the hearts of Londoners—an aim as ineffectual as it was barbaric. Never has there been a raid in which so much damage was done, in brilliant moonlight, to buildings of architectural and cultural value—Westminster Abbey, Dean's Yard, Westminster Hall, the Houses of Parliament, the British Museum, etc. On the other hand, we venture to say, never was there a raid in which so little damage was done to objectives of military importance. One of the editors of NATURE had occasion to go from Westminster through a heavily raided area while the attack was at its height; and once again he was firmly convinced of the absolute futility of this form of attack—futile from the point of view of the Nazis' own war strategy. For the enemy did nothing to further his own aims, though he did much against them in rousing the ire of the British and, afterwards, the contempt of every balanced thinker throughout the world.

The *Völkischer Beobachter* stated that "British broadcasting reports that London is one single sea of flames—the Luftwaffe's heaviest retaliation attack on the British metropolis". Retaliation, in modern warfare, is useless; it is merely an expression of hysteria. The same newspaper asserted that "Naturally the British again assert that our mass attack was indiscriminate, but the High Command reports objectively that the region round the bend of the Thames—that is, the centre of London's docks and business quarters, was again the focus of attack". The considerable area through which one of the editors passed was being deliberately attacked and continued to be the objective of incendiaries and high explosives for several hours. That area is miles from the London docks. Furthermore, nowhere did he see signs of terror, but heroic battling with the fires and grim though calm working on ruined buildings while bombs continued to rain down. No amount of this kind of brutal bombing of buildings which are a nation's—even a world's—heritage and of helpless civilians can bring such a people to its knees. Neither can it help the enemy one jot; rather does it condemn him as unworthy of the wonderful heritage that should be his in his own country, unworthy of all that art and science are able to place at his disposal. Other cities—Plymouth, Bristol, Liverpool, Glasgow, Manchester, Birmingham and many others—will assuredly voice the same opinion.

New Type of Airscrew

INFORMATION has just been released of the successful use of a new type of airscrew on British aircraft, principally those of the Fleet Air Arm operating from the deck of an aircraft carrier. It consists of two co-axial airscrews, one directly behind the other, rotating in opposite directions, each having controllable pitch blades. The development of this device, known as a 'Contraprop', is due to the necessity for turning into thrust the rapidly increasing horse-power being given by the latest aero-engines. Up to 2,000 h.p. is now given by engines coming into service, which on certain types of fighters gives speeds of more than four hundred miles per hour.

The principal trouble in absorbing such powers has been the increase of diameter of the airscrew. The limit, both aerodynamical and practical, is now about reached, in the increase of diameter and multiplication of blades. The placing of one propeller behind the other defeats both of these troubles and simplifies the problem of undercarriage design, especially of the tricycle type, by allowing the machine to be lower, as the smaller diameter needs less ground clearance. Airscrew torque, which causes a machine to tend to swing to one side when taking off, is cancelled out by the opposing directions of rotation. This is important in the case of machines taking off from a confined space such as an aircraft carrier's deck. The absence of torque also increases the rapidity of certain manœuvres in the air. A special control, combined with the adjustable pitch mechanism, enables either propeller to be kept working if the other is damaged, which in effect increases the reliability of the power unit as a whole. For fighting purposes it is made so that cannon can fire through the centre of the hub if required. It is claimed that the device can be produced at no greater weight than a single propeller capable of absorbing equivalent power.

The Transport Problem in Great Britain

THE appointment of Mr. F. J. Leathers to the new post of Minister of War-time Communications, thus combining the duties of Minister of Transport and Minister of Shipping, is to some extent an answer to criticisms of the transport systems of Great Britain made in the eighth and tenth reports of the Select Committee on National Expenditure. Both reports are highly critical of the lack of foresight which has allowed the present shortage of coal supplies and stocks and the difficulties in handling shipping at the docks to develop. Even under war conditions, the Sub-Committee on Transport Services considers that a ship can be unloaded and loaded again more quickly than transport can take traffic from, or bring traffic to, the ports. The failure to secure the existence of equipment such as powerful cranes and elevators which could be transported to and erected at the ports where need arose is strongly condemned. The Sub-Committee recommends the acceleration of delivery or transfer of such mechanical equipment and also that there should be no cessation

of work in ports during 'alerts' unless danger is imminent. While the appointment of regional port directors by the Minister of Transport has been welcomed, the Sub-Committee points out that time alone will show whether such appointments, in some cases of men without previous experience of all the ramification of shipping and port management, is likely to bring success in discharging adequately and efficiently the very onerous responsibilities involved in securing the rapid clearance of both ports and ships.

Other recommendations in the tenth report include the acceleration of manufacture of railway wagons of special type; closer co-operation at overseas ports between the Ministries of Shipping and Transport so that cargoes may be more suitably arranged with a view to their ultimate destinations; transfer of suitable engineers from industry to the merchant service and employment of an experienced shipbuilding engineer to visit repairing yards and suggest improvements in mechanical equipment. More ship repairs should, where possible, be effected abroad and among all practicable steps to overcome transport difficulties, the Sub-Committee reiterates its recommendation in the eighth report that particular attention should be directed to the possibility of curtailing or withdrawing passenger trains on specified days to permit more freight trains to be moved.

While the Sub-Committee considers that it is impracticable in war-time to contemplate a scheme submitted to them for concentrating railway traffic at stations 20 or 30 miles apart for exchange with road vehicles, and closing intermediate stations, such a scheme might repay further consideration after the War. In the meantime the Sub-Committee is awaiting the results of an investigation of the possibility of greater use being made of the canal system and also of proposals for using road transport in greater volume to assist the railways in clearing docks and other centres. It severely criticizes the failure of Government departments to consult the Mines Department when extensions or new factories are planned, and recommends that such Departments should be required to provide the Mines Department with quarterly estimates in advance in areas where supplies are short and future needs will expand. It also recommends that a more comprehensive scheme be planned at once to create coal stocks to meet next winter's demands, and that closer co-operation should be organized between coal merchants to pool requirements of stocks of household coal, labour and local transport.

British Standards Institution

SOME months before the outbreak of war, the British Standards Institution offered the Government its services, as a complete unit, in the national emergency. This offer, which was sent to the Board of Trade, through which the Institution receives its Government grant, was cordially received. On the outbreak of war, the Institution set up a number of small executive committees for the various sections of its work, these being made fully responsible for the preparation of any war emergency specifications required. A statement has now been issued outlining the Institution's recent activities. The Institution has been invited to send a representative to appropriate meetings of the Materials Committee of the Production Executive, which is representative of all Government departments, the Central Priority Department acting as the liaison between that Committee and the Institution. The first issue of the War Emergency Specifications for Tins and Cans for food products and other commodities is estimated to have saved 40,000 tons of steel in the first year, while it is estimated that the War Emergency Specification for Bolts and Nuts with smaller heads will save many thousands of tons of steel a year.

Another example of the work of the Institution concerns alloy and special steels. A committee under the chairmanship of Dr. W. H. Hatfield, has for some time past been engaged on an investigation of this complex problem and has drawn up a confidential report which includes suggestions for a co-ordinated series of steels. Such sections of the report as can be made available to the engineering public are being issued by the Institution, which at the same time is issuing War Emergency British Standards covering the steels recommended in the report. The Ministry of Works and Buildings is using the Institution for the promulgation, under its authority, of a series of War Emergency British Standards, and about fifty specifications in connexion with A.R.P. work have been issued at the request of the Ministry of Home Security.

Such work of immediate importance has not prevented the British Standards Institution from maintaining its close relationship with the Dominions' standardizing bodies. In addition, the Institution's Committee in the Argentine Republic, which is working in close collaboration with the Argentine national standards organization, is receiving increased recognition, as its work is seen to be of real value to British export trade. British engineers and traders in the Argentine are to a greater degree giving practical support to the work of the Committee. The Institution, with the help of the British Council and of industry, is also engaged in compiling a number of technical handbooks dealing with British industrial practice. The books are to be published in Spanish and Turkish.

Gypsy-Lore

EVER since the time of Borrow the mystery of the gypsy-folk has intrigued those of us who have seen, and still occasionally see, their caravans encamped in some lovely dell; and Borrow would have been the first to welcome the serious study which since his day has been devoted to these people so that now we know much more about them than he could. The mystery, however, still remains. The current number of the *Journal of the Gypsy-Lore Society* makes interesting reading, its subject-matter ranging from the sixteenth century in Transylvania to modern

times in Spain. Especially dramatic, if of no great scientific importance, is the account of an unusual friendship struck up between an Englishman and a gypsy youth as the result of help given in a brawl in a Montparnasse estaminet. The two eventually travelled together to visit the gypsy's parents in Madrid—shortly before the lad himself was killed in an accident.

The gypsy language naturally becomes modified by the speech of the people among whom the wanderers have penetrated. Thus Bosnian Romani shows signs of the influence of the Slavonic language with which it is most closely associated, and in this connexion a preliminary study of Bosnian Romani and of certain North Albanian texts will doubtless be of interest to language students. One cannot help wondering what these alien wanderers who still survive among so many of the warring European nations can be thinking, if they think so widely, of the present suicidal struggle of their hosts.

Place-Names in the United States

THAT the study of place-names, apart from its intrinsic interest, is an invaluable source of illuminating evidence for archæologist, anthropologist and social historian, has become a commonplace among all who are familiar with the publications of the English Place-Name Society. Analogous studies of place-names of Indian origin have been made in the United States; but there the untrustworthy character of early documents, if not their complete absence, is a difficulty which is only partially overcome by reference to those few survivors who are still acquainted with the original Indian language. Dr. J. P. Harrington, of the Smithsonian Institution, arrives at the meaning of names of Indian origin in the eastern United States by reference to Delawares now resident in eastern Oklahoma, whose language is one of the few eastern languages still surviving, predominantly the tongue of the Pennsylvanian Indians at the time of first settlement. It is interesting to note that many place-name elements were immediately recognized by living Delawares, but others remained doubtful, even when the words were reconstructed by them out of the basic elements of their language. Of the names submitted for interpretation, "Chesapeke", for long a puzzle to students, is said to be "salt bay" from *chesa* = salt and *peekw* = body of water. Susquehanna is "muddy river", and Monongahela, "caving banks". Potomac, which previously had been interpreted as "carrying place" or "centre for trading", is now construed in the opposite sense as a place where a man lays down a burden, resting place—presumably the place at which Indian war or trading parties took a rest when they came in sight of some village approximately in the present position of the city of Washington.

Indian Fisheries

A report on a survey of the fisheries of Bengal by Dr. R. Naidu (Bengal Govt. Press, 1939) which has only recently been received, contains valuable information on the present state of the Indian fisheries. There is a descriptive account of the fishing methods, followed by details of the commercially exploited groups of fishes in the different parts of Bengal and of the recent work done in other provinces to improve the fisheries. The hilsa or the Indian shad (*Hilsa ilisha*) is the most popular food fish of Bengal; the report makes it clear that unless hatcheries are provided and protective legislation enacted, this valuable fishery will rapidly be depleted at the present rate of fishing. The condition of the carp fisheries, which come next in importance, is equally unsatisfactory, for, though carp culture is widely practised in Bengal, the methods in vogue are wasteful and destructive. The dried fish and prawn industries are considerably developed in the province, but the methods of preparation of the products for the market leave much to be desired. Analysis of the fishing trade points to the deplorable economic condition of the fishing populations who form the backbone of the industry; though fish are plentiful and prices high, a disproportionately high percentage of the profits go to the middlemen who intervene between the fishermen and the consumers. The recommendations made include the organization of a new department with properly equipped stations and personnel, and if given effect to, should substantially improve the fishing industry of the province. Bengal had a separate fisheries department for some time, but it was abolished in 1923. From the facts presented in the report it is difficult to understand how the fisheries of the province could be improved without a properly organized fishery administration.

It is impossible to exaggerate the necessity for developing the fisheries in a country like India where a high percentage of the population is undernourished; the supply of good fish throughout the country by efficient methods of storage and transport would not only raise the nutritional standards of the people but would form also the basis of an industry which has great scope for expansion. We understand that quick-freezing refrigeration plants have already been installed in some parts of India. There is, unfortunately, no organized plan of development of the fisheries of the country as a whole; while some provinces like Madras are ahead of the others, most provinces have no fishery departments at all. The attitude of the provincial Governments seems to be that the departments should mainly rely on their own income for expansion; this short-sighted policy has very much limited the activities of the existing departments. Much work remains to be done to elucidate the habits and life-histories of Indian food fishes. Recent work on some of them has been noticed in NATURE (**146**, 657; 1940). The problem is too vast to be tackled by the fisheries departments alone. We venture to suggest that they should enlist the co-operation of Indian universities and other institutes which have provision for post-graduate research, by providing grants-in-aid for investigating specified problems. In any case a central body to co-ordinate the work done at the different centres would be essential.

Private Estates and Forestry

A PAPER on this subject was read by Major C. P. Ackers before the Royal Society of Arts on February 26, 1941. Some introductory remarks on the history of forestry in Great Britain were made and forestry education was alluded to. It is incorrect to say that forestry education seriously started at Oxford under the late Sir William Somerville. The late Sir William Schlich took forestry to Oxford when the R.I.E. College, Coopers Hill, was closed in 1905. Somerville was the first lecturer in forestry at the University of Edinburgh; afterwards his connexion was with agriculture. Major Ackers correctly states that the position of British woodlands of all types and ownership had sunk to a very low management before the War of 1914–18 and with the exception of the afforestation work of the Forestry Commission and a few isolated private instances the management has scarcely improved since.

Some of the author's ideas for improvement of forestry in Great Britain will not receive general endorsement. Sylviculturally the suggestion that whenever the prospects are reasonably in favour, mixed crops of conifers and hardwoods should be grown, is sound. Such mixtures are admittedly more difficult to manage than pure crops or mixed crops of conifers. But it is true to say that in many parts of England and certain parts of Scotland and Wales they would fulfil soil requirements and the local country-side markets, besides re-introducing small local industries. Although it must remain true that Great Britain could never grow enough wood, etc., to supply the requirements of its population, yet with equal truth it may be asseverated that a long-term policy is essential. Such an indispensable condition has so far never been conceded by either Government or private owner.

Swine Influenza in Britain

IN a paper on this subject read before the Section of Comparative Medicine of the Royal Society of Medicine on April 23, Mr. F. Blakemore said that swine influenza has been extensively studied in America and a somewhat similar disease named *Ferkelgrippe* has been described in Germany and most European countries, including Northern Ireland. It has not been recorded in Great Britain, but many clinicians maintain that a specific pneumonia causes considerable loss, so that it is important to study the etiology of the disease and ascertain its relationship to conditions investigated elsewhere. An outbreak of influenza affecting pigs 10–14 weeks old in which the symptoms were typical of those described by Shope in America was investigated. In severe cases there was a lobular pneumonia affecting principally the anterior lobes. The mortality was low but recovery was slow.

Hæmophilus influenzæ was recorded from half the pigs examined, and the presence of a virus was demonstrated by the intranasal instillation of a filtrate of pneumonic lung. The virus was afterwards established in ferrets, and neutralizing antibodies were demonstrated in the blood of convalescent pigs to the ferret-adapted virus. An investigation of a further four selected outbreaks of pneumonia in pigs revealed the presence of a virus and in two of these the agent was adapted to the ferret. *Hæmophilus influenzæ* was obtained from only a few of the pigs; other infecting bacteria were *Pasteurella suiseptica*, *Br. bronchiseptica*, Salmonella, streptococci and unidentified Gram-positive bacilli. An attempt was made to ascertain the incidence of influenzal pneumonia by examining the lungs of pigs at a public slaughterhouse. Lesions of the kind found in outbreaks previously studied were observed in a proportion of cases. *Hæmophilus influenzæ* was recovered from three of forty affected lungs obtained from the slaughterhouse. Transmission experiments with material from two lungs were carried out. The disease was readily reproduced in pigs, and one of the strains was later adapted to the ferret.

Effect of Low Temperatures on Aircraft Metals

TEMPERATURES as low as $-60°$ C. may be reached by parts of the structures of aircraft flying at great heights. S. J. Rosenberg (*J. Res., Nat. Bur. Stand.*, **25**, 673; 1940) has examined the effect of low temperatures, down to $-78°$ C., upon the tensile properties, hardness, and impact resistance of metals commonly used in building aircraft. For the materials tested, including ferritic steels, austenitic stainless steels and nickel alloys and light metal alloys (Al- and Mg-base), none of these mechanical properties was adversely affected by low temperatures with the exception of a decrease in impact resistance of ferritic steels as the temperature fell. In common with all papers published in this journal, the present paper may be bought as a separate reprint (Research Paper R.P. 1347), from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.

Dr. James Hope

DR. JAMES HOPE, one of the most eminent London physicians of the first half of the nineteenth century and one who contributed much to our knowledge of diseases of the heart, was born at Stockport, Cheshire, on February 23, 1801, the tenth of a family of twelve. He studied medicine at Edinburgh, where he qualified in 1825 with a thesis on aneurysm of the aorta. After spending two years in foreign travel including a year in Paris under Chomel, he settled in London in 1828 and soon acquired an extensive practice. He made numerous contributions to periodic literature on heart disease, and in 1831 published his chief work entitled "A Treatise on Diseases of the Heart and Great Vessels", which comprised a new view of the physiology of the heart's action according to which the physical signs are explained. In the following year he was elected a fellow of the Royal Society. In 1834 he was elected assistant physician and in 1839 full physician to St. George's Hospital. His second most important work was published in 1833 and 1834, entitled "Principles and Illustrations of Morbid Anatomy adapted to the Elements of

M. Andral and to the Cyclopædia of Practical Medicine, being a complete series of coloured lithographic drawings from originals by the author". He died on May 12, 1841, at the early age of forty.

Spectrochemical Literature

THE second volume of *Spectrochemical Abstracts*, covering the years 1938–39 and edited by E. H. S. van Someren, has just been issued by Messrs. A. Hilger, 98 St. Pancras Way, N.W.1. More than 150 papers and books are listed under authors' names, and the classification of substances analysed and elements determined is very thorough. The pamphlet is a valuable summary of material scattered in many journals.

Books and papers of metallurgical interest are similarly covered by the *Bibliography of Spectrochemical Analysis* compiled by D. M. Smith and published by the British Non-Ferrous Metals Research Association, Euston Street, N.W.1. The second edition, costing three shillings, has been brought up to date, to August 1940, and now includes more than five hundred entries. A new section on Application of the Microphotometer lists twenty-one researches. Short explanatory notes are given with most of the references and an author index is provided.

Earthquake in Manchuria

AN earthquake of considerable intensity is reported to have taken place early on May 6 in northern Manchuria. Insufficient reports have so far been received to fix the epicentre with any precision but it must have been fairly close to Suihwa, forty miles north-east of Harbin, where thirty-three were killed and several injured. It is also reported that scores were killed and injured in other nearby cities. It will be recalled that one of the larger earthquakes of 1940 took place in Manchuria on July 10.

Institution of Electrical Engineers: Awards

THE Council of the Institution of Electrical Engineers has made the following award of premiums for papers read during the session 1940–41, or accepted for publication: *Institution Premium:* Mr. C. F. Booth; *Ayrton Premium:* Mr. W. A. Cook; *Fahie Premium:* Messrs. A. Fairweather and J. Ingham; *John Hopkinson Premium:* Mr. G. H. Rawcliffe; *Kelvin Premium:* Messrs. C. E. R. Bruce and R. H. Golde; *Extra Premiums:* Mr. C. G. Garton, Messrs. L. Gosland and W. F. M. Dunne, Prof. Willis Jackson and Mr. A. E. Chester, Dr. R. Jessel, Messrs. W. J. Mason and S. A. G. Emms, Mr. G. H. Metson, Mr. A. Langley Morris; *Wireless Section Premiums:* Messrs. N. M. Rust, O. E. Keall, J. F. Ramsay and Dr. K. R. Sturley (Ambrose Fleming Premium), Messrs. C. A. Mason and J. Moir, Dr. R. H. Barfield; *Meter and Instrument Section Premiums:* Dr. A. E. W. Austen and Dr. S. Whitehead, Mr. A. J. King, Dr. R. W. Guelke, Mr. C. R. Maguire and Dr. R. A. Scott; *Transmission Section Premiums:* Mr. F. R. Perry (Sebastian de Ferranti Premium), Dr. C. Dannatt and R. A. Polson.

Announcements

THE Sir John Kennedy Medal of the Engineering Institute of Canada has been presented to Lieutenant-General A. G. L. McNaughton, commander of the Canadian Corps in Great Britain and lately president of the National Research Council of Canada. General McNaughton described the present position of research in Canada before a meeting of the Royal Society of Arts on May 13; we hope to print a substantial part of this lecture in an early issue.

PROF. L. G. M. BAAS BECKING, professor of botany in the University of Leyden and director of the well-known Leyden Botanical Gardens (NATURE, 142, 1013; 1938), is now in custody in a prison at Scheveningen, Holland.

DR. THOMAS MIDGLEY, JUN., of Kinetic Chemicals, Inc., has been awarded the Priestley Medal, the highest award of the American Chemical Society, for his discovery of the anti-knock properties of tetraethyl lead, as well as other outstanding achievements in chemical science. Dr. Midgley has already been awarded the Nichols, Longstreth and Perkin Medals.

THE thirty-first annual May Lecture of the Institute of Metals will be delivered in the New Clarendon Laboratory, Oxford, by Dr. F. Simon, reader in thermodynamics in the University of Oxford, on May 28. Dr. Simon will speak on "The Significance of Low Temperature Research". Admission is by ticket, obtainable free of charge, from the Secretary, Institute of Metals, 4 Grosvenor Gardens, London, S.W.1, or the Secretary, Clarendon Laboratory, University Museum, Oxford.

THE following appointments in the Colonial Service have recently been announced: D. T. Lloyd, surveyor, Sierra Leone; E. B. Lambert (assistant superintendent of Crown lands), superintendent of Crown lands and surveys, Hong Kong; L. Lord (formerly divisional agricultural officer, Ceylon), secretary to Colonial Advisory Council of Agriculture and Animal Health and assistant to Agricultural Adviser, Colonial Office.

THE following appointments in the University of Sheffield have recently been made: Dr. S. A. Peyton, University librarian; Mr. F. J. S. Esher, assistant lecturer in mental diseases; Mr. M. Laird, junior demonstrator in anatomy; Mrs. Mildred John, part-time demonstrator in anatomy.

The Council has received from the executor of the late Mrs. E. G. Willis a cheque for £1,000 in payment of a legacy left to the University for the foundation of a scholarship in engineering or metallurgy in memory of her late husband, Mr. T. W. Willis.

The collaborators of the late Prof. R. V. Wheeler have presented to the University a complete set of his published researches, together with a glass cabinet to contain the volumes.

The Council has received the resignation of Dr. F. E. E. Schneider of his post of assistant lecturer in mental diseases, and Mr. T. C. Joyce of his post of lecturer in electrical engineering.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Mandible of a Young Paranthropus Child

ONE of the difficulties in making comparisons of the Taungs and the Sterkfontein and Kromdraai apes has been that the Taungs ape is only known by the skull of a 4–5-year-old child, while the other apes are only known by adult specimens and a fragment of the jaw of a 10-year-old Sterkfontein ape. Now fortunately we have a little further evidence.

RIGHT LOWER MILK DENTITION OF VARIOUS PRIMATES AND MAN. FIRST INCISOR HAS BEEN OMITTED AS IT IS UNKNOWN IN PARANTHROPUS AND IMPERFECT IN AUSTRALOPITHECUS.

A, Baboon (*Papio comatus*), probably female; *B*, Taungs ape (*Australopithecus africanus*), possibly male; *C*, Kromdraai ape (*Paranthropus robustus*), probably female; *D*, Kaffir child (*Homo sapiens*); *E*, chimpanzee (*Pan* sp.), probably female. All figures very slightly enlarged.

For more than a year, owing to the War and other conditions, no work has been done at Sterkfontein or Kromdraai; but three weeks ago I went out to Kromdraai and set my assistant to work at a promising spot. He was immediately successful in getting part of a lower jaw with beautifully preserved teeth of a child ape a little younger than the Taungs child. The right second incisor, the canine, and the two milk molars are almost perfectly preserved and scarcely worn. The first true molar is satisfactorily preserved, but had not yet cut the gum.

On the left side we have the first milk molar and part of the canine.

There can be little doubt that this is the jaw of a young *Paranthropus robustus*. It was found within 6 ft. of the spot where the type was discovered. The first true molar is a little smaller than in the type, and this new specimen is probably a female.

When the teeth are compared with those of the Taungs ape (Australopithecus) it is manifest that the two young forms belong to different genera. I give drawings of these teeth, with for comparison drawings of the lower milk teeth in a number of other Primates and man. If the Australopithecus teeth are compared with those of Paranthropus, it will be seen that they all differ very considerably. The Paranthropus second incisor is much smaller than in Australopithecus, and so is the canine. The first milk molar in Paranthropus, while essentially similar in structure to that of the Taungs ape, differs markedly in the shape and in the arrangement of the cusps. The second molar is longer and narrower than in the Taungs ape, and it also differs considerably in the arrangement of the cusps.

There is little doubt Paranthropus and Australopithecus belong to the same family, but they cannot be very closely allied.

If the human milk molars are compared with those of Australopithecus and of Paranthropus it will be seen that there is considerable agreement, and one might almost consider the possibility of all three types belonging to one family. There must be some close affinity.

If we compare the Australopithecine and the human teeth with those of the chimpanzee we at once see a very marked difference. In the chimpanzee the second incisor and canine are much larger than in these others, and differently arranged; while the first milk molar is so very unlike those of the other forms here shown that any affinity must be remote.

In the gorilla and the gibbon, according to figures published by Röse, the first lower milk molars have a single main cusp which is clearly the antero-external cusp of the human milk premolar. In some specimens of the gorilla tooth there appears to be also a rudiment of the antero-internal cusp. In the chimpanzee there is generally a rudiment of the antero-internal cusp close to the large main cusp. In the orang there are also the two cusps practically fused into one. A glance at the figure given of the chimpanzee tooth will show how greatly it differs from the teeth of the Australopithecines.

The second milk molar of Paranthropus has the usual five cusps seen in the corresponding human tooth. It also has a little cusp between the two main inner cusps. This little extra cusp is frequently found in man. It is a Cercopithecid character that has been retained. The Paranthropus tooth is also interesting in having a very marked anterior fovea. This is a typical human character. It is present in all the Kaffir baby skulls I have examined. It is present, but much less developed, in Australopithecus. This is also a Cercopithecid character. It is well marked in the gorilla and the orang, but rather less developed in the chimpanzee.

It is interesting to observe that the probably Lower Pleistocene Australopithecus, in the structure of its milk teeth, comes considerably nearer to man than does the much later and probably Middle Pleistocene Paranthropus; and that neither of the fossil forms has any close affinity with the living anthropoids, all of which have specialized away from the ancestral type. Paranthropus retains a few more Cercopithecid characters than does Australopithecus, or man.

R. BROOM.

Transvaal Museum,
Pretoria.
April 6.

Influence of Vitamin D upon the Incisor Teeth of Rachitic Rats

IT has long been known that vitamin D exerts a profound influence upon the calcification of developing teeth. The action of this vitamin in massive doses upon the persistently growing incisor of the rat has been described by Schour and Ham[1] in the normal animal and by Schour, Tweedy, Chandler and Engel[2] after parathyroidectomy. In both cases the change in the dentin consisted in essentials of a hypocalcified stripe followed by a reactive hypercalcified zone. It does not appear, however, that the reaction of the dentin has been followed in rachitic rats given curative doses of the vitamin.

Through the kindness of Dr. H. A. Shapiro of the Union Health Department, I have been able to examine the teeth of rats used for vitamin D assay. The negative controls were given for 31 days a rachitogenic diet with a Ca/P ratio of 4·8. The

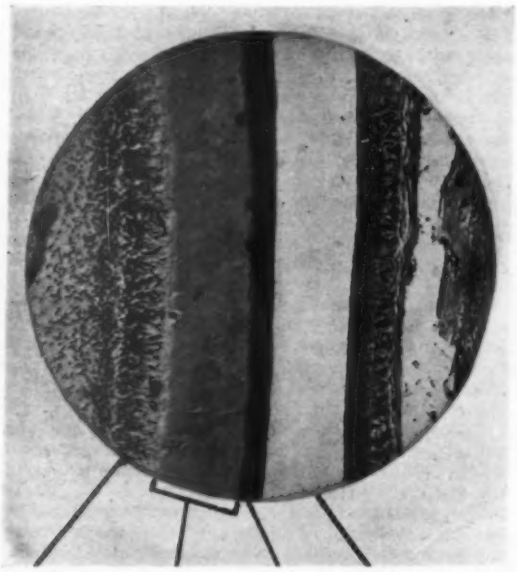


Fig. 1.

LONGITUDINAL SECTION OF THE UPPER INCISOR TOOTH OF A RAT ON THE VITAMIN-FREE DIET FOR 31 DAYS. NOTE VERY WIDE PREDENTIN. × 90. (No. 8.)

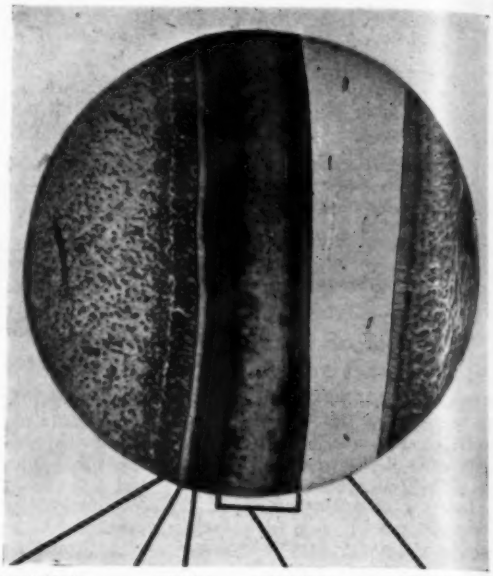


Fig. 2.

LONGITUDINAL SECTION OF THE UPPER INCISOR TOOTH OF A RAT ON THE AVITAMINOUS DIET FOR 31 DAYS AND WHICH RECEIVED 9·2 I.U. OF VITAMIN D ON THE 21ST DAY. NOTE THE DENTIN AND PREDENTIN FORMED BEFORE THE DOSE OF D WAS GIVEN AND THE REACTIVE DENTIN AND PREDENTIN FORMED UNDER THE INFLUENCE OF THE VITAMIN. × 90. (No. 4.)

treated animals were on this diet the same length of time but received in addition a dose of 9·2 I.U. of vitamin D on the twenty-first day. Both sets of animals were killed and examined on the thirty-first day. The upper incisor teeth were cut in longitudinal section and the changes in the dentin were investigated.

The incisors of the three negative control animals studied all showed in the dentin the changes usually found in this condition—very wide predentin with vascular inclusions in several places (Fig. 1). Marked changes in the enamel and enamel organ not pertinent to the present study were also found.

The teeth of the six animals which had received the dose of vitamin D all had a markedly different appearance from that noted in the controls. The changes in these teeth were all the same in type, varying somewhat from animal to animal (Fig. 2). In each, a reactive stripe of new dentin, staining deeply with hæmatoxylin, was laid down as a result of vitamin medication. This intense calcification affected only the dentin matrix laid down after the vitamin had been given. The predentin laid down previous to this was either completely unchanged or else showed a few scattered calcified granules; and in some cases a little calcification had occurred round the vascular inclusions, giving the appearance of finger-like projections of hæmatoxylin-staining material into the old predentin. The contrast between the dentin calcified before and after giving the vitamin was very marked, as can be seen from Fig. 2. It is difficult to understand why the old

predentin was not more altered, seeing that this was being calcified, though with difficulty, while the animal was on the deficient diet alone. A similar inability to calcify predentin laid down during a dietary deficiency has been noted when animals on a magnesium-deficient diet are returned to one of normal magnesium content[3].

The new dentin plus predentin differed considerably in width from animal to animal, as will be seen from the table. By dividing this width by that of the predentin laid down just before the animal was killed, an estimate could be made of the length of time vitamin D had been acting on the tooth. The figures so obtained varied from 4·2 to 6·5 days. It was assumed in this calculation that the daily increments of new dentin were equal in width to that of the new predentin. This assumption was supported by the fact that in the animal from which the figure of 6·5 was obtained, the new dentin showed six incremental stripes, which together with the predentin formed 24 hours before the animal was killed would indicate that the vitamin had acted on the tooth for seven days. These figures are on an average rather smaller than those obtained from bone by Morgareide and Manley[4], who found, using radioactive phosphorus, that rachitic metaphyses reacted 54–72 hours after dosage with vitamin D.

The depth of staining of the new dentin indicated that after ten days the D administered was still exerting a marked action.

INFLUENCE OF VITAMIN D UPON THE INCISOR TEETH OF RACHITIC RATS

Rat No.	Treatment	Width of new predentin (μ)	Width of new dentin and predentin (μ)	Days of dentin response	Degree of healing of rickets. (Line test)
1	31 days on rachitogenic diet, 9·2 I.U. of D on 21st day.	14	74	5·3	3·5
2		10	46	4·6	1·0
3		12	50	4·2	1·0
4		12	60	5·0	3·5
5		13	84	6·5	3·0
6		10	44	4·4	0
7	31 days on rachitogenic diet only.	—	—		0
8		—	—		0
9		—	—		0

Some correlation was noted between the width of new dentin plus predentin and the healing in the bones as measured by the line test (Dyer[5]). The widest reactive dentin was found in those rats that showed the highest degree of healing and the narrowest in those with little or no healing. It would thus appear that the tooth is more sensitive to the action of D than are the epiphyses and also that a time element enters into the degree of healing of bony rachitic lesions. It is possible that if rat No. 6 had lived longer, it might have shown some healing of the bones. It should be noted that the reaction of the dentin in all teeth, judged histologically, was equally intense whether it started early or late.

It is intended to develop these observations further in a study of the action of vitamin D.

J. T. IRVING.

Department of Physiology,
University of Cape Town.

[1] Schour, I., and Ham, A. W., *Arch. Path.*, **17**, 22 (1934).
[2] Schour, I., Tweedy, W. R., Chandler, S. B., and Engel, M. B., *Amer. J. Path.*, **13**, 971 (1937).
[3] Irving, J. T., *J. Physiol.*, **99**, 8 (1940).
[4] Morgareide, K., and Manley, M. L., *J. Nutrition*, **18**, 411 (1939).
[5] Dyer, F. J., *Quart. J. Pharm. Pharmacol.*, **4**, 503 (1931).

Desorption or 'Surface Melting' of Lubricant Films

A RECENT communication[1] has described the effect of temperature on the lubricating properties of mineral oils. The apparatus used for the experiments was that devised by Bowden and Leben for analysing the frictional force between sliding surfaces. In this apparatus the bottom surface is driven steadily forward, but the upper surface is mounted on a bifilar suspension so that it has a certain degree of freedom and can respond to any changes in the frictional force. Using this apparatus they have shown that the sliding between steel surfaces lubricated under boundary conditions with certain mineral oils and with other lubricants may not be continuous but may proceed by a process of 'stick and slip'. In general, this jerky motion is observed with non-polar lubricants which are not adsorbed or are only weakly adsorbed on the metal surfaces. With certain polar molecules, such as the long-chain fatty acids which form strongly adsorbed layers, the motion changes over to continuous sliding. It was also found[2] that the polar oxidation products which may be present in solution in some mineral oils or which are formed in the oil by heating may act in a similar way and may cause continuous sliding. The experiments described in the previous communication[1] have shown that, if the surfaces are warmed, these adsorbed polar substances may be driven off the surface, and the motion may change over to stick-slip. This transition, which is a reversible one, may occur at quite moderate temperatures, for example, 50° C., and is accompanied by an increase in wear.

These experiments have been continued with a number of pure straight-chain hydrocarbons on steel surfaces. Some of the later measurements were made by Mr. J. J. Frewing. Bowden and Leben's observations[3] that *solid* films of saturated hydrocarbons or of straight-chain alcohols give continuous sliding and that the transition to stick-slip occurs *at the melting-point* have been confirmed. It was also found that *liquid* films of the fatty acids give continuous sliding and that this persists when the surfaces are warmed up. *When the temperature was raised to about 75° C. above the melting-point, however, the transition to stick-slip occurred.* The typical behaviour of a fatty acid is shown in F 1. These results are for lauric acid.

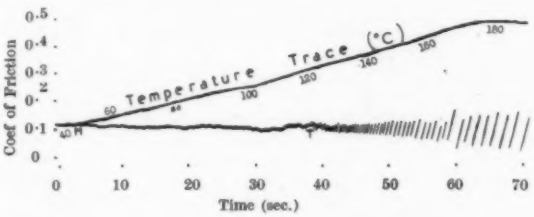


Fig. 1.

The upper trace records the temperature, and the lower trace the friction. It will be seen that at first smooth sliding occurs and the friction is reasonably constant, and there is no change at the melting-point (M). At the point T, however, the transition to stick-slip occurs. The effect was reversible and, on cooling down, the return to continuous sliding

occurred at the same temperature. The measurements were made on a homologous series of fatty acids from pelargonic to stearic and the results are plotted in Fig. 2. Curve I gives the melting point of

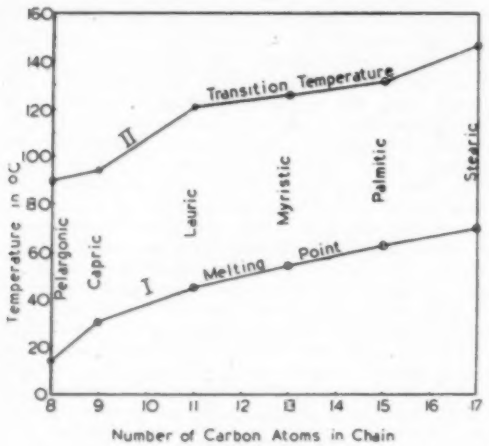


Fig. 2.

the samples used, and Curve II the temperature at which the transition from smooth sliding to stick-slip occurred. It will be seen that there is a separation between these curves which is nearly constant and is approximately equal to 75° C.

It is suggested that the transition from smooth sliding to stick-slip is due to the desorption or disorientation of the adsorbed film or to a change of state from a closely packed to a less closely packed form. The fact that this 'surface melting' of the adsorbed film occurs at a temperature 75° C. above the bulk melting point in the case of the acids, close to the melting point in the case of the corresponding alcohols, and at the melting point in the case of the corresponding hydrocarbons, is interesting. At the melting point of the bulk solid, sufficient kinetic energy is distributed among the molecules to enable them to overcome their attraction for one another. In order to melt the adsorbed film, sufficient energy must be available to overcome this mutual attraction plus their attraction for the surface. The difference between the transition temperature and the bulk melting point may therefore be regarded as a measure of the strength with which the polar group is attached to the steel surface.

The results suggest that this analytical frictional method provides a useful weapon for measuring the strength and for studying the mechanism of the adsorption of various polar groups on to solid surfaces. Apart from their theoretical interest, these observations are of considerable practical importance. If a lubricant contains suitable polar substances it will give smooth sliding and low wear at room temperature but, when the temperature is raised, the adsorbed film responsible for this may be driven off. The temperature at which this occurs may be below 100° C. and may be easily attained by many parts of a running engine. It is clear that this must be taken into consideration, both in the testing of a lubricant and in its selection for practical use.

I am indebted to members of Dr. Bowden's research team in the Laboratory of Physical Chemistry at Cambridge for helpful discussions and to the Asiatic Petroleum Company for permission to publish the work, which was carried out in their laboratories.

Britannia Laboratory,
Britannia Place,
Cambridge.
D. TABOR.

[1] Tabor, NATURE, 145, 308 (1940).
[2] Bowden, Leben and Tabor, *Trans. Faraday Soc.*, 35, 900–904 (1939).
[3] Bowden and Leben, *Phil. Trans.*, A, 239, 1–27 (1940).

"The Man of Science as Aristocrat"

IF I may say a word more about "The Man of Science as Aristocrat", I would like to point out to my friend Lieut.-Colonel Moore-Brabazon that my suggestion, as Sir Richard Paget realizes, was of an inner aristocracy of the spirit in an entirely democratic world. I did not suggest that men of thought and knowledge should rule or control anybody or anything outside the range of their distinctive gifts. I suggested that within that range they should refuse absolutely to be directed, controlled or silenced by anybody, that they should bear themselves like brains with a backbone, and not like flexible slaves.

13 Hanover Terrace,
N.W.1.
H. G. WELLS.

MR. H. G. WELLS[1] states that he was once in danger of becoming corruptingly rich by patenting films, and that "Mr. Paul came along to me and we took out a provisional patent that would have made us practically the ground landlords of the entire film industry" (NATURE, April 19, p. 465).

My provisional specification described means for presenting the main incidents in Mr. Wells's story, "The Time Machine". To create an illusion of travelling through time spectators were to be seated on a rocking and oscillating platform and subjected to wind and noise effects. Pausing at various epochs —past, present and future—they were to see appropriate events shown on a screen by means of animated photographs and dissolving views. It was to discuss details of such scenes that I invited Mr. Wells to my office in Hatton Garden towards the end of 1895. He listened patiently to my proposals, gave his general approval to my attempting to carry them out, and proceeded to talk of subjects suitable for the primeval scenes. Having recommended for my perusal some books on extinct monsters he left without further discussion as to future action, and many years elapsed before I had the pleasure of meeting him again.

My scheme was promptly abandoned for reasons which can be guessed by those acquainted with animated photography in 1895. Then one-minute films could be watched by individuals who looked through the slot of an Edison kinetoscope or one of its variants. In several countries inventors, including myself, were seeking means for showing films on a screen, and such projectors came into use early in 1896. The simplest scenes, coupled with the novelty of seeing photographs moving, sufficed to attract the public and to establish the new art of cinematography in favour. A prolonged presentation, such as that of "The Time Machine", was then unnecessary and indeed impracticable.

ROBT. W. PAUL.
High Street,
Sidford, Devon.

RESEARCH ITEMS

The Genitalia of Hymenoptera

THE morphology of the external genitalia of male insects has received a good deal of attention in recent years, and one of the most active workers in this field is R. E. Snodgrass, of the U.S. Department of Agriculture. His most recent contribution to this subject deals with the male genitalia of the order Hymenoptera (*Smithsonian Misc. Coll.*, **99**, No. 14, Washington, 1941, 86 pp., 33 plates). The author concludes, in regard to insects in general, that the primary genital ducts in the male must have opened on the tenth segment of the abdomen. Paired penes, giving individual exit to these ducts in Ephemeroptera and certain Dermaptera, appear to belong to this segment. The median genital organ of other insects is termed by Dr. Snodgrass the phallus, which is formed by the union of a pair of genital lobes arising, in most cases, on the ninth abdominal segment. The nature of the so-called claspers is fully discussed, and while it is conceded that these structures are derived from the phallus in some orders of insects, in others, including Heteroptera, Mecoptera, Trichoptera, Lepidoptera, and Diptera, he says that there is no conclusive evidence as to the nature of the movable claspers borne on the 'coxal plates' in the orders named. In the Hymenoptera the development of the phallus is from a pair of rudiments on the ninth abdominal segment. Characteristic genital features of the order are the lateral parameral lobes or 'valvæ externæ', a median œdeagus, a pair of volsellæ or 'valvæ internæ' and, in bees, the sagittæ or 'penis valves' in addition. All these components are derived from an original phallus, and include no counterparts of the claspers found in those orders listed above.

Incidence of Lice

AN investigation has recently been carried out by K. Mellanby at the request of the Board of Education and the Minister of Health with the object of discovering the incidence of the head-louse in England. In a memorandum enclosed with Circular 2306 (Ministry of Health) and Circular 1544 (Board of Education), it is stated that infestation of the body is rare in children. As the result of an examination based on approximately 60,000 cases in hospitals, it is found that a very high degree of infestation with head-lice exists in industrial cities, and that girls are more frequently infested than boys. In industrial cities infestation in girls reaches a peak at three years old (51·6 per cent), and similarly in boys, but at the rate of 40 per cent. In the rural areas the percentage of children infested is very low. There is, it appears, no evidence that louse infestation, though widespread, is increasing. All the evidence points to the fact that education and improved social conditions have resulted in it being less common and less severe than in the past. The conclusion is reached that education of the public is the only method likely to yield permanent success. While local authorities have powers to take appropriate action, it must be premised that the desired improvement of conditions will be secured by a continuous use of administrative measures for treating cases which have arisen and by educational efforts rather than by resorting to powers of compulsion.

Frost Resistance in Plants

IN the now voluminous literature on this subject it is evident that two physical factors in the organization of protoplasm are of importance in determining hardiness: the percentage of bound water and the permeability to water. Increase in either of these properties, or of both, is involved in increase in hardiness. Some light is thrown on the relation of these properties to hardiness by Siminovitch and Levitt (*Canadian J. Res.*, **19**, 9; 1941) in an investigation of the physical properties of the protoplasm in several hardy and non-hardy species. The surface membrane of non-hardy cells stiffens when dehydrated osmotically and therefore ruptures readily when subjected to tension on deplasmolysis. This stiffening either fails to occur in hardy cells or arises as a result of much greater dehydration. The volume enclosed by the membrane can be reduced in these latter tissues to less than one third of its initial value without any sign of deplasmolysis injury, whereas in non-hardy cells a reduction to only two thirds causes death on deplasmolysis of more than 50 per cent of the cells. A further difference brought to light by these plasmolytic experiments is the clumping of plastids and granules (systrophy) in non-hardy but not in hardy species consequent upon prolonged immersion in a plasmolyticum. With regard to other physical properties, the refractive index of the protoplasmic surface increases more on dehydration in non-hardy than in hardy cells, and oil drops injected into plasmolysed cells readily become crescent shaped in non-hardy cells on deplasmolysis, but not so readily, if at all, in hardy cells. All these facts indicate a greater hydrophily in hardy than in non-hardy species both of the surface membrane of the protoplasm and, possibly to a lesser extent, of the protoplasm as a whole. This is obviously in harmony with the above-mentioned views concerning bound water and permeability.

Lily Mosaic

THE ninth volume of the Royal Horticultural Society's Lily Year Book (from the Society's office, Vincent Square, Westminster, S.W.1; 1940, 5*s*. paper, 6*s*. cloth) contains a useful review by D. E. Green and M. A. H. Tincker of the damage caused to lily plants by the mosaic virus. Many species of the genus Lilium frequently show the characteristic leaf mottling symptoms of the disease, which usually destroys a stock within three or four years. Malformation and dwarfing of the flowers is also found, with diminution in size of the bulbs. The malady is distributed by the insect vector *Aphis gossypii*, which can be largely controlled by frequent application of nicotine dust. Infection by the virus often occurs in the seedling stage, though the disease is not truly seed-borne. *Lilium speciosum* and *L. auratum* were the host species particularly studied, and stocks of the former survived for a longer period at Wisley than did the latter, which is very susceptible.

Rust-Resistant Antirrhinums

D. E. GREEN reports progress on the selection of strains of Antirrhinum resistant to the rust fungus *Puccinia Antirrhini*, in a recent short paper (*J. Roy. Hort. Soc.*, **66**, Pt. 3; 1941). Resistant forms were

obtained from the United States, but were not florally desirable; the problem was first to select a series of parent forms with flower colours suitable for decorative combination. This has now been accomplished, and five rust-resistant strains of varying flower colour have been established. It is not yet known if they are resistant to a second physiological race of the parasite which has appeared in the United States.

Trisomics in Nicotiana

T. H. Goodspeed and P. Avery (*Proc. U.S. Nat. Acad. Sci.*, **27**, 13–14; 1941) have found the twelfth primary trisomic in *Nicotiana sylvestris* ($n = 12$). This trisomic, Stiff, has extremely long flowers and stiff leaves which easily distinguish it from the diploid and the other eleven known primary trisomics. Stiff arose from the cross $3n - 1 \times 2n$ as a double trisomic with Puckered. This in turn gave 24 diploid, 12 Puckered, 14 Stiff and 3 double trisomics. Stiff has also arisen from the progeny of an asynaptic form of the trisomic Inflated.

Determination of Arsenic

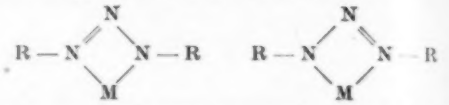
At a meeting of the Society of Public Analysts and other Analytical Chemists held on February 5 H. J. G. Challis described the interference of selenium and tellurium with the determination of arsenic by the hypophosphorous acid method. In the method of B. S. Evans for the determination of arsenic by separation with hypophosphorous acid and subsequent iodimetric titration, if selenium or tellurium is present errors are caused inasmuch as these elements also are precipitated by hypophosphorous acid and are oxidizable by iodine. To avoid these errors a modification of the method is described in which the hypophosphorous treatment is carried out first at 50° C. for half an hour. This precipitates selenium and tellurium but not arsenic, and after filtration the arsenic is precipitated from the filtrate at boiling temperature as described by Evans.

Underground Water Supply of Calcutta

An inquiry from the Corporation of Calcutta as to the nature of the strata below the Gangetic delta, arising from a proposal to install deep tube-wells, led to the preparation by A. L. Coulson of Water Supply Paper No. 1 (*Mem. Geol. Surv. India*, **76**, 150; 1940) which contains a systematic account of all the relevant information. After a general description of the Indo-Gangetic plains and the Ganges delta, the question of the maximum thickness of the alluvium and the discrepancy between the geological evidence and that afforded by geodetic observations is discussed. Theories are given for the origin of the 'swatch of no ground' off the Ganges delta. Detailed information gained from the sinking of tube-wells in Calcutta and its vicinity during the last 135 years is compiled. It is pointed out that the rate of flow of the underground water is slow and that considerable mutual interference must be expected between wells sunk too close together. As to the sources of the water, it is concluded that while there is a south-easterly flow from the Damodar river, the bulk of the underground supplies is replenished by slow southward percolation from the Brahmaputra and Ganges. It is pointed out that there is some danger of exhausting the supplies if numerous wells are sunk to tap the aquifers. It is recommended, however, that an experimental tube-well boring should be sunk to a depth of 5,000 feet or less, according to whether or not the basement rocks underlying the Gangetic alluvium are encountered before that depth is reached. A gradual coarsening of the beds with depth is expected, until the Tertiary marine strata or the Supra-Panchet rocks are struck. It is the gravel beds—if these are proved to exist—immediately overlying the basement rocks that will most likely furnish water under artesian conditions.

Metallic Triazine Complexes

The preparation of a number of metallic salts of diazoamino compounds and the determination of their molecular weights, by F. P. Dwyer (*J. Amer. Chem. Soc.*, **63**, 78; 1941) show that they should be formulated as inner complex salts in which the triazine group functions as a chelate (2-co-ordinating) group, and with the possibility of resonance (leading to stability) between the two structures:



Two compounds prepared appear to be the first examples of hexacovalent palladous compounds described, the triazine groups being probably octahedral about the metallic atom in *cis* positions. F. P. Dwyer and D. P. Mellor (*J. Amer. Chem. Soc.*, **63**, 81; 1941) by magnetic susceptibility measurements show that nickel complexes of diazoaminobenzene and 4-4′-dimethyldiazoaminobenzene are diamagnetic and hence in them the nickel atoms have a square co-ordination configuration. In that case the triazine group appears to function as a chelate group. Molecular weight determinations show that two deep red diamagnetic complexes are dimeric in benzene; on boiling, this structure gradually breaks down into the monomeric form, the change being reversed on cooling. The dimeric forms involve an 8-membered ring of nitrogen atoms bridging the nickel atoms which is very unusual, although there is evidence for its occurrence with *bis*-ethylenediamine cobalt complexes with sulphonyl diacetic acid and with homophthalic acid.

Crystal Structure of Iodic Acid

An X-ray examination of the structure of the α-modification of crystalline iodic acid by M. T. Rogers and L. Helmholz (*J. Amer. Chem. Soc.*, **63**, 278; 1941) shows the presence of discrete pyramidal IO_3' groups in the crystal with the observed I–O distances 1·80 A., 1·81 A., and the O–I–O angles 96°, 98° and 101°. Three oxygen atoms in positions approximately opposed to the three-bonded IO_3 oxygens and at distances 2·45, 2·70 and 2·95 A. complete a distorted IO_6 octahedron with three strong bonds and three weaker ones. The hydroxyl oxygen atom of each iodate group has two nearest oxygens at 2·78 A. There are thus two hydrogen bonds for each iodate group forming a moderately strong bifurcated bond. The oxygen atoms are in a somewhat distorted closest packed arrangement and the structure somewhat resembles that of perovskite. Crystalline iodic acid is an aggregate of HIO_3 molecules held together by hydrogen bonds, and secondary I–O bonds of the type observed for arsenic and oxygen in arsenolite.

Stability of Crystal Lattices

In the fifth of a series of papers, R. Fürth (*Proc. Camb. Phil. Soc.*, **37**, 34; 1941) deals with the relation of some experimental results and recent theories of the equation of state and the melting of solids. After a short survey of Born's theory of the thermodynamics and melting of crystals it is shown that Lindemann's and Grüneisen's law for the normal melting temperature can be deduced. Values in good agreement with experiment are got for the dependence of the melting temperature on pressure and for the dependence of the compressibility and elastic constants on pressure and temperature. Several connexions between breaking and melting, suggested by the fundamental ideas on melting and stability of crystals, are discussed and verified. A relation between heats of melting and of sublimation gives values of the correct order of magnitude (see also NATURE, **145**, 741; 1940).

Reagent of Aldehydes

A 1 per cent solution of N,N-dibenzyl-*m*-phenylenediamine in 95 per cent alcohol is proposed as a reagent for aldehydes by F. G. Singleton and C. B. Pollard (*J. Amer. Chem. Soc.*, **63**, 240; 1941). The test is carried out by placing two drops of the substance in a test-tube and adding 5 ml. of the reagent. Saturated aliphatic aldehydes give a red initial colour followed within ten minutes by a bright green fluorescence which becomes stronger on standing; formaldehyde is exceptional in giving a yellow initial colour and no fluorescence. Unsaturated aliphatic aldehydes give a darker red initial colour than saturated, and a dull brownish-green fluorescence appears within ten minutes; hexadiene-2,4-al and cinnamaldehyde show unusually dark red initial colours but no fluorescence. Aromatic aldehydes give initial colours which vary from bright yellow to dark red, and a bright green fluorescence appears only after two or three hours.

Long-Chain Polar Compounds in Lubrication

THE effect of long-chain polar compounds on the coefficient of kinetic friction under boundary conditions has been studied by O. Beeck, J. W. Givens and A. E. Smith (*Proc. Roy. Soc.*, A, **177**, 90; 1940). The Boerlage four-ball friction apparatus in various modifications was used, and the structure of thin films of lubricants rubbed on polished mild steel surfaces was examined by electron diffraction. For oils which showed high surface orientation imparted by addition of long-chain polar compounds, a sudden decrease of the coefficient of friction was observed at various velocities of the sliding surfaces, depending upon the compound used. Those compounds in which the effect occurred at the lowest velocities were found to be most highly oriented with their carbon chains most nearly perpendicular to the surface. At the regions of sudden decrease of the coefficient of friction the electrical resistance between the sliding surfaces changes from a low value, corresponding to metallic contact, to an extremely high value. The effect is explained as a 'wedging' of oil under the surface.

The Ellipticities of the Earth and Moon

JEFFREYS has recently combined six data relevant to the ellipticities of the earth and moon and found the agreement satisfactory (*Mon. Not. Roy. Astro. Soc.*, **101**, No. 1; 1941). These are the secular motions of the node and perigee, the monthly term in the moon's latitude, the inclination of the moon's axis, the annual libration in longitude and a new determination of the ellipticity term in gravity recently made by Jeffreys himself. Following work by Brown and Spencer Jones, and using Belkovitch's solution concerning f in preference to that of Franz and Stratton, Jeffreys obtains:

$$J = 0{\cdot}0016377 \pm 0{\cdot}0000042 \ (0{\cdot}0000062 \ s.e.)$$

giving $\frac{1}{\varepsilon} = 297{\cdot}05 \pm 0{\cdot}38 \ (0{\cdot}56 \ s.e.)$. This value has about the same apparent accuracy as Heiskanen's and the international gravity formula (Potsdam standard) is modified to

$$g = 978{\cdot}049\,(1 + 0{\cdot}0052895 \sin^2\varphi - 0{\cdot}0000059 \sin^2 2\varphi).$$

It has been suggested by Browne and Bullard that the first factor should be 978·032 but that the change should not be made until the connexions between Potsdam, Cambridge and the National Physical Laboratory have been strengthened. According to Jeffreys the constants for the moon are now:

$$J + \tfrac{1}{2}K' = 0{\cdot}0003733 \pm 0{\cdot}0000011 \ (0{\cdot}0000016 \ s.e.)$$
$$K' = 0{\cdot}000073 \pm 0{\cdot}000023 \ (0{\cdot}000034 \ s.e.)$$
$$f = 0{\cdot}804 \pm 0{\cdot}062 \ (0{\cdot}092 \ s.e.)$$

An outstanding difficulty is still the disagreement between the moon's dynamical and visual parallaxes, which Jeffreys suggests may be due to an abnormal deflection of the vertical at Cape Town.

The Ellipticity Term in Gravity

JEFFREYS has recently made a new estimate of the main ellipticity term in gravity (*Mon. Not. Roy. Astro. Soc.*, Geophys. Supp., **5**, No. 1; 1941). Taking the existing observations of gravity over the surface of the earth, forming summaries of the free air anomalies over 10° squares and reducing to the mean height of the square so as to eliminate the correlation of the free air anomaly with height, it was hoped to determine the harmonics of low order other than the main ellipticity term. It was found that the observations were unsuitably distributed for such a determination owing chiefly to lack of data for the South Pacific and high southern latitudes, but they did yield a new estimate of the main ellipticity term in gravity. This ellipticity turned out to be the reciprocal of 296·80 ± 0·71.

Diffuse Radiation in the Galaxy

THE so-called interstellar 'absorption' of light which gives rise to the dark nebulæ is likely to be (at least in part) scattering rather than absorption. This being so, those regions of the Milky Way rendered least luminous to the naked eye because the light of distant stars is absorbed should show a faint background of diffuse light due to scattering by the interstellar particles. This has been recently verified by Henyey and Greenstein (*Astrophys. J.*, **93**, 70; 1941), who used for the purpose a Fabry photometer attached to the 40-in. refractor of the Yerkes Observatory. Surface brightnesses of the sky were measured photographically across the Milky Way at several points, choosing fields free from stars brighter than mag. 16 so as to reduce the correction for unresolved starlight. After correcting for the light of faint stars, for direct and scattered auroral light, and for zodiacal light, these observations indicate a diffuse radiation concentrated closely to the galactic equator and reaching there a value equivalent to some 60 tenth-magnitude stars per square degree; more in the dark regions, less in the transparent areas. This diffuse light can be explained as scattered stellar radiation if the phase function governing the scattering is strongly forward-throwing.

MEASUREMENT OF ATMOSPHERIC OZONE BY A QUICK ELECTROCHEMICAL METHOD

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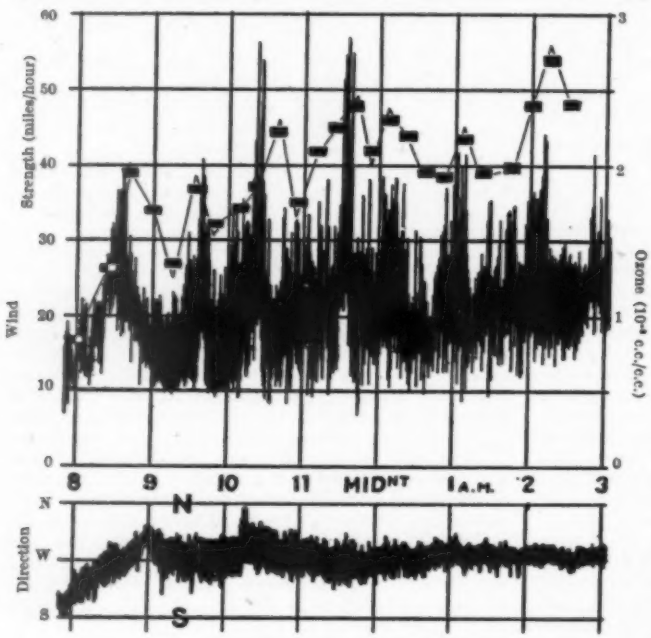
AT a conference held at Oxford in September 1936 the need for a chemical method of determining atmospheric ozone, and the objections against those applied so far, were discussed[1]. Two years later a procedure was described which avoided the earlier drawbacks: by condensing ozone on cooled silica gel it was possible to reach a concentration sufficient for safe identification by specific reagents and absorption spectrum, and for a reliable titration[2]. The process is, however, cumbersome, and the hope was expressed that, after establishing this trustworthy method by which to test others, a much simpler one might be found sufficiently exact for meteorological purposes[3].



The method described here seems to meet this requirement; it is at the same time very fast and continuous and lends itself to automatic recording. Its main features are: (1) the atmospheric ozone is absorbed in a potassium iodide solution under conditions which exclude wall reactions; (2) the liberated iodine is measured by its depolarizing effect on platinum electrodes; (3) the periodic addition of constant quantities of thiosulphate restores the initial conditions and makes it possible to take ozone readings every two minutes or so, unless the atmospheric ozone concentration is much below average.

The course of the chemical reaction between ozone and iodide is influenced by the presence of a glass surface; this heterogeneous reaction is responsible for the production in neutral solutions of iodate, besides iodine, and for the catalytic decomposition of part of the ozone[4]. In our apparatus the air enters at high speed through a nozzle, thereby spraying potassium iodide solution vigorously throughout the reaction vessel and bringing ozone and liquid in close contact without interference of the glass walls. The reaction of ozone with the fine spray of buffered neutral solution is found to be quantitative even at concentrations as low as 10^{-8} c.c. of ozone per c.c. of air, and is apparently entirely homogeneous, as no iodate is formed. The sprayed liquid is collected and, by the suction of the nozzle, circulated back to the inlet tube; on its way it flows rapidly over two platinum electrodes having a potential difference of 10 mv. An electric current can pass only if the cathode is depolarized by an oxidizing agent[5]; free iodine of less than a millionth normality permits the passage of currents easily measurable by a galvanometer. This apparatus achieves the absorption of ozone from air, passing at the rate of about 1,000 litres per hour, with 15 c.c. of potassium iodide solution; the evaporating water is replaced by using a highly diluted ($N/2{,}000$) solution of thiosulphate for titration.

We have tested the reliability of the new method by carrying out a parallel determination with the condensation method by which ozone is separated from nitrogen dioxide[2]. It was found that there was no nitrogen dioxide present, and the ozone values agreed within 2 per cent. Moreover, tests have shown that, under the conditions of our procedure, nitrogen dioxide liberates very little, if any, iodine from a neutral potassium iodide solution; thus the method is practically specific for ozone.

We hope to employ the method for a systematic study of the occurrence of ozone in the troposphere and lower stratosphere. So far we have investigated its dependence on the intensity and direction of local winds. More than seventy years ago a connexion between ozone concentration and wind was announced[6]. It was rediscovered several times[7]; quite recently the application of a micro-method[8], based on the principle of passing air over, instead of through, a potassium iodide solution[9], rendered it possible to follow fairly quickly the effects of wind changes[10]. We made use of our faster and simpler method, and of the facilities offered by the University Observatory—situated about one mile to the south-west of Durham

City—to compare closely ozone and anemometer readings taken on the same spot.

It was found that winds from the north-east, coming from Durham City, never contained ozone; on the contrary, our apparatus showed the presence of reducing substances (probably sulphur dioxide from burnt coal) which were not detectable—even after destruction of ozone with active charcoal—in westerly winds. These winds, if exceeding 5 miles per hour, nearly always contained ozone. Stagnant air had none, but showed reducing qualities. The parallelism between ozone content and wind velocity was most impressive on days with heavy gusts of westerly wind. The accompanying figure is a reproduction of the Dines anemometer record for the night of December 5/6, 1940, on which the ozone values are inserted (the length of the markings indicates the duration of the measurements); it can be seen that every ozone maximum follows closely on a series of high gusts, a time lag of a few minutes being noticeable.

The reality of such a time lag—easily understandable—was also clearly shown when the wind suddenly, and for a considerable time, changed its direction (see the following table giving anemometer and ozone values for March 21, 1941). It took several minutes before the ozone-containing air masses had been swept away after sudden veering of the wind to the north-east.

Time Interval G.M.T.	Direction	Wind Velocity (miles/hr.)	Ozone content (in 10^{-6} c.c./c.c. air)
10.31 to 11.10	W.N.W.	20 to 15	3·6, 3·0, 3·1, 2·8, 3·6, 2·9, 2·9
11.10 ,, 11.13	sudden change to N.E.		2·3
11.13 ,, 11.17		15 to 12	3·6, 3·1
11.17 ,, 11.19	N.E.	12	rapid fall to < 0·1
11·19 ,, 11.45		12 to 10	< 0·1

There are, however, observations which indicate changes others than those due to local contamination. Early during the depression of December 5, 1940, the ozone concentration decreased from $2{\cdot}1 \times 10^{-6}$ to zero more than two hours before the thermograph showed the arrival of a warm front, the wind being south-south-west the whole time, and even gaining in strength; the quick rise of the ozone to $1{\cdot}9 \times 10^{-6}$ at 8.40 p.m. (visible in the figure) was accompanied by a turning of the wind to west and closely followed by the passage of a cold front. Similar observations were made during depressions on November 20 and 27 and December 10. Such measurements, if carried out in regions free from artificial contaminations, may be as helpful for the study of large-scale turbulence in the troposphere[11] as that of 'ozone clouds'[12] in the stratosphere. Another fact already emerging from the data collected is an increase of about 100 per cent in the average ozone content from November 1940 to March 1941; this constitutes an obvious parallelism with the spectrographic measurements of the total ozone in the atmosphere[13] and thus seems to confirm the views about a correlation between tropospheric and stratospheric ozone[14].

A fuller description of the procedure and results will be published later.

We desire to express our thanks to the Department of Scientific and Industrial Research for a grant; to the curators of Durham University Observatory for providing facilities to work there; and to Mr. P. R. Monk for his help in preliminary experiments carried out in 1939 at the Imperial College in London.

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INFLUENCE OF GEOLOGY ON THE HEALTH OF GRAZING ANIMALS

By Dr. George Dunlop and Dr. W. J. McCallien

A SURVEY has been made in south-west Scotland of the distribution of vinquish, a debilitating disease of sheep referred to by Aiton in 1810 as being prevalent in this area. The disease shows certain affinities to: coast disease of South Australia (1), wasting disease of Western Australia (2), bush sickness of New Zealand (3), nakuruitis of Kenya (4), moor cling of Devon (5), pining of the Scottish borders (6), salt sickness of Florida (7), pine of the Hebrides (8), and neck ail of Massachusetts (9).

The geological features of the areas on which these deficiency diseases occur are varied but can be grouped as follows: (*a*) æolian deposits of sand and comminuted shell fragments (1, 7, 8, 9); (*b*) granite and other igneous intrusions and lavas (2, 3, 4, 5); (*c*) areas geologically complex (6).

Following the work of Marston and his colleagues[10], it was shown that the daily administration of small amounts (< 1 mgm.) of cobalt quickly cured animals suffering from certain of these maladies (2, 3, 4, 5, 6),

copper as well as cobalt was essential for the cure of (1), iron and copper for (7), and iron alone for (8, 9). In curative experiments on vinquish a daily dose of 40 mgm. iron + 10 mgm. copper was administered to 16 animals, of 10 mgm. copper to 17 animals, and of 1 mgm. cobalt to 21 animals. Cobalt alone was effective, all the animals recovering quickly from the disease. It appears, therefore, that vinquish in our area is a straight cobalt deficiency.

The accompanying diagram (Fig. 1, below) illustrates the distribution of vinquish in south Ayrshire. Comparison of this diagram with the geological sketch-map (Fig. 1, above) at once suggests a fairly close relationship between the disease and the geology of the region. The exact nature of this relationship is not yet known, but it is worth considering at this stage of the investigations.

The Southern Uplands Fault is the most conspicuous structural feature of our area. The sharp division of vinquish from non-vinquish grazings along the line of the fault may be illustrated by the following examples:

(*a*) Vinquish is unknown on farms with the fault as their northern march.

(*b*) Farms with the fault as their southern boundary are affected.

(*c*) Where the farm extends across the fault the hefts to the north are affected and those to the south are clear. (A heft is a group of sheep—usually 3–8 score—grazing together within natural boundaries.) Near the head of Loch Doon, a hirsel, comprising

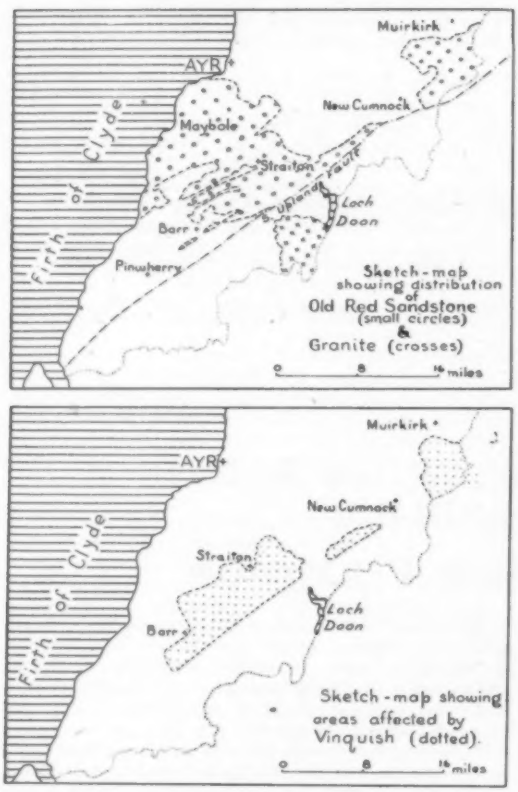

Fig. 1.

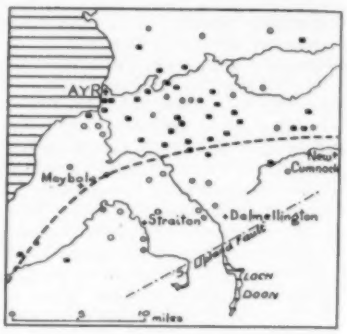

Fig. 2.

DRIFT AND MINERALOGICAL SKETCH MAP OF SOUTHERN AYRSHIRE.

Heavy broken line: boundary between northern and southern drifts. Black rectangles: soil carrying more than 2·9 per cent heavy crop. Circles: soil carrying up to 2·9 per cent heavy crop. Based on Elder and McCall.

four hefts, stretches across the fault. On the most westerly heft there is only a small proportion of ground to the north of the fault, but this proportion increases with each heft until on the most easterly the grazing is largely on the north side. Cases occur sporadically among the first lot of ewes, but the number of affected sheep increases on each heft to the east until the most easterly is regarded as bad pining ground.

In the area at present under review the Southern Uplands Fault separates the Upper Palæozoic rocks of the Midland Valley from the Lower Palæozoic of the Southern Uplands. The Upper Palæozoic consists chiefly of Old Red Sandstone sediments, andesitic lavas, and intrusions. These all support vinquish grazings, but the disease is most severe on areas of felsite and related intrusions.

The northern boundary of the vinquish areas is defined partly by the appearance in this direction of arable farms. Where hill sheep farms exist the grazings to the north of the dotted areas in Fig. 1, below, are free from vinquish.

The northern boundary appears to coincide with the junction of the drifts of northern and southern origins as determined by the Geological Survey. The difference in the mineralogical composition of these drifts is marked. Mineralogical analyses by Elder and McCall[11] have shown that the ferromagnesian crop from the soils on the northern drift average 4·6 per cent, while on the southern drift the percentage is invariably lower (Fig. 2). It is noteworthy that the soils from the vinquish farms of Auchenroy, Shaws Knowe, Grimmet, and Straiton Moor contain the lowest percentage of ferromagnesian minerals—1 per cent or less.

From what has been said above it seems that there is a close connexion between the geology and the health of the grazing animals and that the Southern Uplands Fault in the region studied in greatest detail (Tairlaw and Knockdon) forms the demarcation between the vinquish-affected and the healthy areas. Field study suggests that the differences in the solid geology are not entirely responsible. Considerable tracts of Old Red Sandstone in the Straiton region are composed of andesitic lavas relatively rich in iron and, therefore, presumably also in cobalt. In

the area south-east and east of Barr the rocks on the two sides of the Southern Uplands Fault are the same, yet the vinquish map shows the same contrast between vinquish and healthy districts as in those parts where the Old Red Sandstone occurs on one side of the fault and the Lower Palæozoic on the other. We have come to the conclusion, therefore, that the nature of the drift is largely responsible for the incidence of the disease.

In general, the Southern Uplands Fault separates a mountainous belt from the comparatively low ground of the Midland Valley. The difference in topography, a conspicuous feature in the landscape of the Knockdon area, may in itself be a factor bearing on the present problem. It has at least been responsible for the restriction of the morainic drift to the country south of the fault and of the boulder clay to the more fertile ground to the north. The boundary between the two types of drift does not actually coincide with the outcrop of the fault, but the disease boundary line may not really coincide any better. One reason behind the distribution of the disease may, therefore, be the physical state of the subsoil, for the two types just mentioned, morainic drift and boulder clay, have been derived from the same parent rocks to the south.

The occurrence of vinquish on the felsitic outcrops indicates that in certain cases in our area there is a direct relationship between rock, subsoil, soil, herbage and morbid condition of the grazing animals.

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WHAT IS A PHYSICIST?

DURING the War of 1914–18 a physics student applied for postponement of military service to enable him to sit for his university examination. One member of the tribunal asked if the student would not be better occupied at a base hospital. Nobody saw the connexion until two words of explanation were given—"mixing physic". At the same time rumour had it that certain physicists working on radio-telegraphy were described officially as chemists because the Services had not officially heard of the term physicist. More recently the literature of popular science has helped to spread the idea that a physicist is essentially a splitter of atoms. In a leading article in the November number of the *Journal of Applied Physics*, published by the American Institute of Physics, fears are expressed that the services of physicists are liable to be neglected because service and business officers are still under the impression that physicists "being only interested in atoms" cannot be expected to be of much assistance.

The definition given by the Institute of Physics in Great Britain to the Ministry of Labour and National Services' Central Register was as follows: "A Physicist is one who has knowledge of, and experience in, one or more branches of physics. Physics includes the study of (1) the properties and nature of matter, (2) heat, (3) light (optics), (4) sound (acoustics), (5) electricity, (6) magnetism, (7) radio-activity; and their applications. *Note.* The technical application of certain branches of physics have become branches of engineering." With the Schedule of Reserved Occupations, the Ministry of Labour and National Service uses the definition: "*Physicist*—is engaged in the study of matter and its general properties as affected by the application of various forms of energy; may be specialized, e.g., in mechanics, heat, light, sound, electricity, radio-activity; the usual qualification is membership of the Institute of Physics and/or a University degree."

When the order for compulsory registration was made in July 1940 any person was considered a physicist who possessed an honours degree in physics of any university of the British Empire, and who was normally engaged as a physicist at any university or in any industry or as a teacher of physics. The number registered under that order was 1,175. Previously, 1,596 persons had registered voluntarily as physicists. Not only in Great Britain is there a scarcity of physicists. In the United States, according to an announcement in the February number of the *Review of Scientific Instruments*, the U.S. Civil Service Commission had to extend the closing date for receipt of applications for entry to the civil service examinations for physicists. The salaries attached to the posts were: physicist (any specialized branch), 3,800 dollars a year; principal, 5,600 dollars; senior, 4,600 dollars; associate, 3,200 dollars; and assistant, 2,600 dollars a year.

The difficulties of creating physicists when they are wanted for work in applied physics is perhaps difficult to realize for those who claim to be able to make a soldier from a civilian by giving him ten weeks' training. In its twenty years of life the Institute of Physics in Great Britan has worked hard in urging the importance of physics in industry. This work of national importance has had to be carried out at the cost of members of the Institute. That such work places a severe strain on the resources of the Institute is clear from the difficulties of the American Institute of Physics. Details of the help given by the Chemical Foundation to get the Institute safely launched were given in the thirteenth number of the *Rheology Leaflet*. When the help ceased, a deficit of 21,845 dollars had been accumulated by December 1937. In 1939 this had been reduced to 12,840 dollars. Now the Rockefeller Foundation has generously helped. In the same number of the *Review of Scientific Instruments* it is reported that "a drastic decline in foreign dues and subscription income caused by the War in Europe has now threatened to cancel the gains which have been made. In response to the Institute's appeal

on this account, the Foundation has generously granted the sum of 20,000 dollars to assist the Institute to adjust the publication program to the new circumstances." In the preparation for, and prosecution of, wars the nations seem to have no difficulty in finding huge sums of money. Yet the bulk of research is still carried on by the aid of charity. The dearth of physicists and the financial difficulties of publication are not therefore surprising. On consideration, it is an odd state of affairs that the publication of scientific work benefiting, or at least used by, the whole world should still be paid for largely by the research workers themselves through their subscriptions to scientific societies.

BANANA FERTILIZER INVESTIGATIONS IN JAMAICA

INVESTIGATIONS of the effect of fertilizers on bananas are few in number, particularly in the great producing areas in the Caribbean region. In Jamaica, where many estates have been long under cultivation, and where Panama disease and soil erosion are tending to force cultivation on to new areas of lower fertility, a full knowledge of fertilizer requirements is rapidly becoming of paramount importance. The results of recent investigations by Croucher and Mitchell (*Bull.* 19, Dept. Sci. and Agr., Jamaica, 1940) are of both theoretical and practical interest, touching as they do on several aspects of the growth requirements of the Gros Michel banana.

The experiments under discussion were begun in 1932, but a succession of hurricanes and droughts prevented the reaping of several of the earlier crops, affording, incidentally, some impression of the difficulties with which the tropical investigator has to contend. The experiments undertaken were of a qualitative type, designed to give information on the general reaction of the banana to applications of the main plant nutrients. In the four different areas selected for experimental plots, different results were obtained: in one a growth response was obtained from nitrogen applications alone; in a second, response was obtained only when potash was applied, but phosphate improved production in the presence of potash; on the other hand, excess phosphate in the absence of potash adversely affected the quality of the fruit produced; in a third area, response was obtained only when phosphate was applied, but, in the presence of this nutrient, further response resulted from applications of potash and nitrogen; in a fourth area, absence of potash precluded the possibility of obtaining commercial fruit.

This brief statement of some of the results so far obtained indicates the wide and useful field that awaits further exploration. The assessment of yield of bananas is not a simple matter, in that it involves a consideration of (*a*) the number of 'hands' per bunch, (*b*) the quality of the individual fruits, (*c*) the rate of production, and (*d*) the population of plants per acre. In some areas nitrogen applications produced an increase in the length of individual fruits—a desirable commercial feature; in others, applications of nitrogen and phosphate also increased the length of fruits, whereas adverse results were obtained elsewhere; potash applications tended to offset undesirable effects resulting from phosphate fertilizers.

FORTHCOMING EVENTS

[*Meeting marked with an asterisk is open to the public.*]

Monday, May 19

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—Dr. Hugh Scott, F.R.S.: "Highlands of Central Ethiopia".

Tuesday, May 20

ROYAL INSTITUTION OF GREAT BRITAIN (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Sir Joseph Barcroft, F.R.S.: "The Development of Function in the Mammalian Organism".*

Saturday, May 24

LINNEAN SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—Anniversary Meeting.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

MAINTENANCE ENGINEER by the British Guiana Government Transport and Harbours Department—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9393).

ASSISTANT ENGINEER for the Government Federated Malay States Railways—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9618).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Liverpool Observatory and Tidal Institute. Annual Report, 1940. Pp. 12. (Birkenhead: Liverpool Observatory.) [284

How to Make Good Silage: an Illustrated Guide for Dairy Farmers. Pp. 32. (Nottingham: Boots The Chemists.) [15

Tin Research Institute. Publication No. 103: Report for 1940, summarising Recent Researches and Developments in the Uses of Tin in Industry. Pp. 24. Publication No. 104: Protective Films on Tinplate by Chemical Treatment. By Dr. R. Kerr. Pp. 14+4 plates. (Greenford: Tin Research Institute.) [15

South-West Essex Technical College and School of Art. Annual Report, Session 1939–40. Pp. 52+12 plates. (London: South-West Essex Technical College and School of Art, Walthamstow.) [15

Proceedings of the Royal Society of Edinburgh. Section B (Biology), Vol. 61, Part 1, No. 3: The Structure of Tulach Hill, Blair Atholl, Perthshire. By Dr. William J. McCallien. Pp. 43–54. (Edinburgh and London: Oliver and Boyd.) 1*s.* 6*d.* [15

Other Countries

Southern Rhodesia Geological Survey. Short Report No. 34: Geology and Mines of the Mashaba District. By R. Tyndale-Biscoe. Pp. 8. (Salisbury: Geological Survey.) [244

Gold Coast Colony. Report on the Forestry Department for the Year 1939–40. Pp. 8. (Accra: Government Printing Department: London: Crown Agents for the Colonies.) [284

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 136: Experimental Studies of Ephemeral Fever in Australian Cattle. By I. M. Mackerras and M. J. Mackerras; with a Section in collaboration with Dr. F. M. Burnet. Pp. 116+2 plates. Bulletin No. 137: A Soil Survey of the Red Cliffs Irrigation District, Victoria. By G. D. Hubble and R. L. Crocker. Pp. 63. (Melbourne: Government Printer.) [284

New Zealand Air Department. Meteorological Observations for 1939. Prepared in the Meteorological Office, Wellington. Pp. 39. (Wellington: Government Printer.) [284

Report of the Aeronautical Research Institute, Tōkyō Imperial University. No. 200: Investigation on the Mechanism of the Cementation of Metals. By the late Masaji Goto, Hirosi Asada and Tuneyosi Okamoto. Pp. 429–476. 90 sen. No. 201: Studies on the Subsonic Flow of a Compressible Fluid past an Elliptic Cylinder. By Susumu Tomotika and Kō Tamada. Pp. 477–552. 1.05 yen. No. 202: Acoustical Studies of the Flutter of an Airscrew (Experiments with Actual Airscrew) (Investigations of Airscrew Flutter, Part 2). By Jūichi Obata, Major Yūzō Matumura, Ryō Kanayama and Yahei Yosida. Pp. 553–590. 70 sen. No. 203: On the Mechanism of a New Transformation, and some Associated New-Reactions in the Iron-Nickel Aluminium System. By Syūiti Kiuti. Pp. 591–720. 2.60 yen. (Tōkyō: Kōgyō Tosho Kabushiki Kaisha.) [15